University of Alberta

Semiotics of Medical Imaging: Inside Out, Outside Looking In

by

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Thank you—

Eun Jin, my ABD wife (사랑해요);
Noel, our sweetest daughter.

Rob, from Carleton to Edmonton;
Marco, another supervisor;
Committee members and other mentors too.

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Archivists et al. for permission to reuse images.

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And here's to Eun Jin's health again.

Abstract

When illness happens, diagnostic technology delivers pathological signs from the patient towards his or her physician who mostly sees things. An interpretation of such data turns ambiguity into synthetic certainty. With this plan based on Gilles Deleuze et al.'s stoicism, I ask: "what are the few consistencies in representing humans?" This dissertation contributes to a history of medical knowledge; for such exploration, semiotics is my chosen method.

Science studies has referred to Algirdas Julien Greimas' notion of actor/actant i.e. social agency; Charles Sanders Peirce seems more faithful to sem(e)iotics' ancient symptomatological legacy. Flat *diagrams* in Peircian vocabulary, consisting of spots and lines, frequently demonstrate the component homology since mediaeval autopsy sketches were copied manually. For example, positron emission tomography measures where and how many isotopes have been concentrated, fulfilling some conditions for resemblance to a decreasing extent. *Indices* or spectra from a person have been, according to Roland Barthes, applied upon mechanically reproduced images.

I conclude by questioning whether visualization helps sharing pain more than language. While the psychology of Peirce merged into behaviorism, that of William James—"an exciting object elicits certain bodily alterations, then our feeling of them is the emotion"—still teaches: if one can distinguish passion from the whole affect, no warning function of suffering disappears under analgesia. There is, at the interpersonal level, a mystery of sympathy—or comfort from the Aristotelian tradition of ethics and rhetoric.

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1. Introduction

Once
In a hollow fennel-stem
Did I
Redress:
Give arms to
Innocents
Oppressed
- for this
I ache
& ache (20 times)

Chris Cutler, "Prometheus"[1]

Diagnostic technologies have evolved over time, with such breaks as Wilhelm Conrad Röntgen's leap ahead into non-invasive anatomy. Nonetheless, three modalities of signifying illness virtually remain as we have depicted corporeality. Drawn from Charles Sanders Peirce's grouping, a medical image can be (1) a *diagram* copying the internal relations of its object analogously, (2) a *metaphor* corresponding qualitatively to what it denotes, or (3) an *index* functioning by quasi-causal contiguity to its referent. They are actually implemented within the given cultural milieux: for example, *diagrammatic* cognition is applied to pre-modern autopsy sketching through contemporary positron emission tomography. In another case, restrictions on human post-mortem, which had prompted dissection of monkeys and pigs as *metaphors* for men, were relaxed before the dawn of Renaissance world-view.

---

[1] in Cassiber, *Perfect Worlds* (Rio De Janeiro: RéR, 1986).

My thesis utilizes those semiotic methods found at the core of communication studies, featuring symptoms in medicine that was an inspiration of sem*e*iology[2] as its subject. The ancient physician Claudius Galen (see **3. 2. 4**), following a Greek tradition concerned with the interpretation of signs while lacking necessary therapeutic skills, called diagnosis a process of semeiosis (*σημειωσις*); its variations—together with *symptomatology*—were used in clinical science until the 18th century. I shall discuss general topics in semiotics e.g. the multiplicity of *iconic* resemblance: even *likenesses* have selectively borne certain—rather than all—characteristics from whatever reality they describe.[3] Subsequently, another issue of communicating pain—an inherently social ethos—is referred to New England pragmati(ci)sm, including Peirce again.

Being an M.A. and B.A. in communication, I have come to a preoccupation with "the Doctrine of Signs" as John Locke established.[4] To begin, semiotic methodology serves the discipline of communications. However, there has been a curious synchronicity between the two in that Roland Barthes developed his "sémiologie" by criticizing post-WWII popular culture[5] by which American media studies were motivated. Before that, nevertheless, the Enlightenment scholars in Britain coined "communicatio" as a wishful term[6] that remains problematic today.

---

[2] Thomas A. Sebeok, *Sight, Sound, and Sense* (Bloomington: Indiana University Press, 1978), viii.

[3] For instance, an echogram consists of motion- (dots), amplitude- (scrolling curve which fluctuates versus the lapse) and brightness-modes where sonographers have employed automation in exaggerating the rough tissue. R. F. Wagner et al., "Texture Discrimination: Radiologist, Machine and Man," in *Vision: Coding and Efficiency*, ed. Colin Blakemore (Cambridge: Cambridge University Press, 1990); Frederick W. Kremkau, *Diagnostic Ultrasound: Principles and Instruments* (St. Louis: Saunders Elsevier, 2006), 145.

[4] J. Locke, *An Essay Concerning Human Understanding*, http://www.ilt.columbia.edu/publications/locke_understanding.html, Book IV. chapter 21.

Σημειωτικη had long been a field whose pioneers would find themselves in the art of healing (*ιατορια*).[7] A definition of *signum*[8] from St. Augustine in the Middle Ages goes: "aliquid stat pro aliquo"—something that stands for something else. More precisely, a medical sign has been defined as: something *exterior* that stands for something *interior*, about which speculations could be made (e.g. malfunction, torment).[9]

---

[5] R. Barthes, "Mythologies," in *Œuvres complètes, t. I* (Paris: Éditions du Seuil, 2002).

[6] From divine attraction from a distance filled—ironically—with void (e.g. gravity; see **6. 2**) to the no less mysterious sharing of privately owned *idea*.

[7] Hippocrates, *Prognostic* (London: William Heinemann, 1959). Susan Petrilli and Augusto Ponzio ask what if the first semioticians were non-authors before Galen or Hippocrates even? in *Semiotics Unbounded: Interpretive Routes through the Open Network of Signs* (Toronto: University of Toronto Press, 2005), 13; see also Jean Bottéro, "La Magie et la médecine règnent à Babylone," in *Les Maladies ont une histoire*, eds. Jacques Le Goff and Jean-Charles Sournia (Paris: L'Histoire/Seuil, 1985).

[8] As urine sample in Umberto Eco, *Semiotics and the Philosophy of Language* (New York: The Macmillan Press, 1984), 15.

[9] Thure von Uexküll, "Semiotics and Medicine," *Semiotica* 38, no. 3/4 (1982): 208. I solicit neither pan-biological trends such as *Umbeltforschung* by his father Jakob J. (1864-1944; lest we should confuse him with Thure's nephew Jakob von Uexkull an environmentalist), see Jesper Hoffmeyer, *Signs of Meaning in the Universe* (Bloomington: Indiana University Press, 1996); nor even broader cybersemiotics—for instance Søren Brier, "What is a Possible Ontological and Epistemological Framework for a True Universal 'Information Science'? The Suggestion of a Cybersemiotics," in *The Quest for a Unified Theory of Information: Proceedings*

More recently, this assumption of corporeality with depth or, at least, the "soul-body" interaction also pertains to the manner in which Gilles Deleuze semantically annotated a few Stoic philosophers.[10]

From communications' viewpoint, I provide a triadic model: (1) illness, rather than any identity that might exist so we verify it per se,[11] *happens* to become (2) signs (*σημα*) now distinctive enough for (3) diagnosis or value judgement. The particular scheme has originated from Epicuro-Lucretianism in general, revised by me (see Figure 1-1 for typology): marks upon tangible materials, protruding from human constellations, fly. Pierre Lévy puts it: "X rays, scanners, nuclear magnetic resonance systems, sonograms, positron cameras—all virtualize the surface of the body […] By means of telepresence and telecommunications systems, visible, audible, and sensible bodies are multiplied and dispersed outside us. As in the Lucretian universe, a crowd of skins or dermatoid spectres emanate from our own body—simulacra.".[12]

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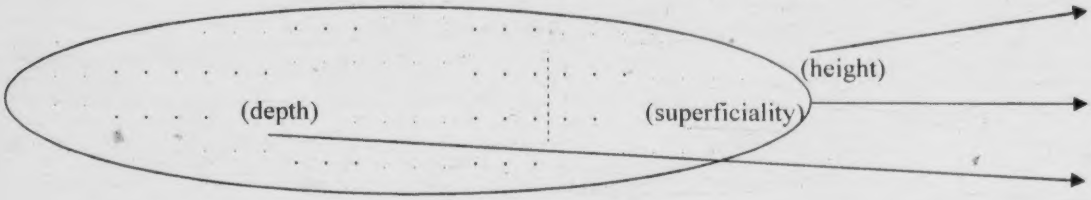
of the Second International Conference on the Foundations of Information Science, ed. Wolfgang Hofkirchner (Amsterdam: Gordon & Breach Publishers, 1999).

[10] G. Deleuze, *The Logic of Sense* (New York: Columbia University Press, 1990).

[11] Mark Harrison, *Disease and the Modern World: 1500 to the Present Day* (Cambridge: Polity, 2004), 6-13.

[12] P. Lévy, *Becoming Virtual: Reality in the Digital Age* (New York: Plenum Trade, 1998), 40.

Figure 1-1. Sources of each sense from matter (*σωηα*)[13]



		sight
odour	taste	
hearing	touch	

When malady has occurred, those pathological indications are emitted off by a suffering person toward some place where the doctor stays; there is a pair of mutually opposite directions, also meaning different ethical implications. First, centrifugal motives have kept a physician from his or her patient: René Théophile Hyacinthe Laënnec invented the stethoscope not to immediately contact a sick girl and presumably tuberculosis victims; fluoroscopic operators began setting themselves 180-210 centimetres off the hazard-emitting cathode tube, a distance greater than it had been until the 1960s. Secondly, centripetal imperatives have *vice versa* brought those geographically far, together: Willem Einthoven developed a method for recording electrocardiograms at his laboratory fed one mile away from Leiden University's hospital. Post-war experiments with acoustic devices reflected a concern about the growing isolation of rural practitioners; and information nowadays travels almost everywhere via broadband Internet connectivity. I will ask if e-health genuinely allows a doctor, who became already less approachable, to meet people waiting to being examined, cured and cared for.

---

[13] Such a philosophical theory, along with Empedocles', can "have some bearing upon the frenetic contemporary sphere of activity." Siegfried Zielinski, *Deep Time of the Media:*

This study is dedicated to a history of "medical technology" although its constituents have quite varied amongst scholars. Photography does not look in as deeply as semiotic imaging; late in the 19th century, a lady's portrait taken onto violet-sensitive emulsions (invented by Hermann Wilhelm Vogel) revealed specks and she afterwards succumbed to smallpox. This prognostic tool *failed* i.e. was forgotten however.[14] Thomas Alva Edison post-radiologically attempted to penetrate the skull and David Starr Jordan to capture thoughts on a "psychic retina," both in vain.[15] These are more than hoaxes since, without people's fascination over extrasensory perception, neither could have rhetorically validated their investigation merely by adopting scientific credibility. The prevalent scholarship especially views modernity as progress towards objective truth

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Toward an Archaeology of Hearing and Seeing by Technical Means (Cambridge: The MIT Press, 2006), 53.

[14] For inventions applied without understanding their principles, see Robert N. Proctor and Londa Schiebinger, *Agnotology: The Making and Unmaking of Ignorance* (Stanford: Stanford University Press, 2008); Ernest B. Hook, ed. *Prematurity in Scientific Discovery: On Resistance and Neglect* (Berkeley: University of California Press, 2002).

[15] Also inventions lead contingently to something that we could not otherwise predict; Sylvère Lotringer and Paul Virilio, *The Accident of Art* (New York: Semiotext(e), 2005).

shown by unprecedented genius which the intellectual groups have confirmed; a different historiography is possible—that of errors.[16]

While computerized axial tomographs (where the series of cross-sectional data from every angle possible are reconstructed on a single plane) imitate our bones, magnetic resonance imaging scans the soft tissue. I earned such an insider's look while volunteering at the Ottawa General Hospital's radiology department; yet, instead of human subjects, my material is drawn from the public domain and archival sources. I read interviews: Joseph Dumit has consulted big names in PET (mapping neural substructures) like Michael E. Phelps, Michel M. Ter-Pogossian and Henry N. Wagner et al.[17] Lisa Meryn Mitchell listened to ultrasound specialists.[18] Nonetheless, audio-transductive sonography will be sparingly discussed.

Anthropology once devalued biomedicine that is "based on the principles of physiology and biochemistry"[19] by relativizing it along with folk therapies (e.g. acupuncture, Hindu rituals and vitalism in their own right)[20] or examining the former as part of the latter.[21] My project doubts the shift from *techne iatrike* to any claim for "sciences" like German histo-pathology in the 1860s and American post-war molecular biology.[22] Arthur Kleinman advised that psychiatrists should recognize sick people's story though,[23] how central it still is—now even with CT and MRI diagnosis—remains a debate (**Chapter 9**). I prefer ethnographers doing semeiotics: both Kathryn V. Staiano and Jacques M. Chevalier built their field research mostly in Latin America on the medical principles of signs and humoural opposition.[24] Dan Sperber declares: "To explain cultural phenomena is […] to develop an epidemiology of representations. For this, representations have to be viewed not as abstract, but as concrete objects which can be of two forms: they are either mental representations inside brains, or public representations in the environment of brains. Just as an epidemiology of diseases has to be rooted in

---

[16] Terry M. Parssinen, "Professional Deviants and the History of Medicine: Medical Mesmerists in Victorian Britain," in *On the Margins of Science: The Social Construction of Rejected Knowledge*, ed. Roy Wallis (Keele: University of Keele, 1979).

[17] J. Dumit, *Picturing Personhood: Brain Scans and Biomedical Identity* (Princeton: Princeton University Press, 2004).

[18] L. M. Mitchell, *Baby's First Picture: Ultrasound and the Politics of Fetal Subjects* (Toronto: University of Toronto Press, 2001), 108-36.

[19] W. A. Newman Dorland, *The American Illustrated Medical Dictionary* (Philadelphia: W.B. Saunders & Co., 1942), 220.

[20] Daniel Callahan, ed., *The Role of Complementary and Alternative Medicine: Accommodating Pluralism* (Washington: Georgetown University Press, 2002); Waltraud Ernst,

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ed., *Plural Medicine, Tradition and Modernity, 1800-2000* (London: Routledge, 2002); Helaine Selin, ed., *Medicine Across Cultures: History and Practice of Medicine in Non-Western Cultures* (Dordrecht: Kluwer Academic Publishers, 2003).

[21] Robert A. Hahn, *Sickness and Healing: An Anthropological Perspective* (New Haven: Yale University Press, 1995), 131-72; Deborah Lupton, *Medicine as Culture: Illness, Disease and the Body in Western Societies* (London: Sage, 2003).

[22] Jean-Paul Gaudillière, *Inventer la biomédecine: La France, l'Amérique et la production des savoirs du vivant, 1945-1965* (Paris: Éditions La Découverte, 2002).

[23] A. Kleinman, *Writing at the Margin: Discourse between Anthropology and Medicine* (Berkeley: University of California Press, 1995).

[24] K. V. Staiano, *Interpreting Signs of Illness: A Case Study in Medical Semiotics* (Berlin: Mouton de Gruyter, 1986), 1-34; J. M. Chevalier, *The 3-D Mind, v. 3—Scorpions and the Anatomy of Time* (Montreal: McGill-Queen's University Press, 2002).

individual pathology, an epidemiology of representations has to be rooted in cognitive psychology."[25]

Hence my ultimate research question for this dissertation using case histories goes: "what are the sem(e)iotic consistencies in visualizing human bodies?" Healing starts at unhealthy corporeal signs or symptoms made semantically easy, and how we have understood them medically since Hippocrates or even beyond him must relate to an issue of sociological importance.

---

[25] D. Sperber, "Anthropology and Psychology: Towards an Epidemiology of Representations," *Man (New Series)* 20 (1985): 73.

2. Theoretical background

> We are interested therefore in the surfaces on which inscriptions are made (paper, rock, plastic, textile, wood, etc.), in the substances with which inscriptions are made (ink, gold, paint, light, etc.) and in the tools used for making the inscriptions (chisel, pen, brush, pencils, stylus, etc.) […] We regard inscription as significant particularly because it is in the process of inscription that unsemioticized materiality is drawn into semiosis. –Gunther Kress and Theo van Leeuwen[26]

This chapter shall highlight two perspectives held by Stoics and semioticians respectively, from which I view the history of diagnostic imaging. A link between them would be that both pursue mediated intelligence.

2. 1. Continental reading of Stoicism

Gilles Deleuze clarified Epicureanism via Stoic ontology. So did another French guru Michel Serres in *La Naissance de la physique dans le texte de Lucrèce* [1977] though, his more elucidating substitutes appeal to us: Régis Debray and Bruno Latour who rather works "on fragile materials—texts, inscriptions, traces, or paints—with other people."[27] Let me add Friedrich A. Kittler upon the system of notation (*Aufschreiben* in German).[28]

---

[26] *Reading Images: The Grammar of Visual Design* (London: Routledge, 1996), 231.

2. 1. 1. Gilles Deleuze

> This century will be known as Deleuzian [...] a lightning storm was produced which will bear the name of Deleuze: new thought is possible; thought is again possible. –Michel Foucault[29]

Deleuze, who (then belonging to the Centre national de la recherche scientifique) had just released *Nietzsche et la philosophie* [1962], met Foucault at the home of Jules Vuillemin near the University of Clermont-Ferrand where Deleuze could have been elected: their fellowship survived fifteen years until Foucault would struggle too much for transition from the first volume of *Histoire de la sexualité* to the second.[30] Deleuze instead joined Paris VIII-Vincennes' faculty in 1969, while Foucault would fill in for Jean Hyppolite (his former École Normale Supérieure mentor as well as Deleuze's at Sorbonne) by getting nominated to the Collège de France. During this post-'68 period, certain philosophers of that burgeoning cohort were into the lines of *flight*[31] or extension from structuralism: Foucault published *L'Archéologie du savoir* whereas Deleuze did *Logique du sens* introducing Stoics and Lewis Carroll, the mathematician a.k.a. Charles L. Dodgson, almost simultaneously.[32]

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[27] B. Latour, *The Pasteurization of France* (Cambridge: Harvard University Press, 1988), 186.

[28] F. Kittler, *Discourse Networks 1800/1900* (Stanford: Stanford University Press, 1990).

[29] "Theatrum Philosophicum." http://www.generation-online.org/p/fpfoucault5.htm; originally in *Critique* 282 (1970): 885-908.

[30] François Ewald, foreword to "Désir et plaisir," by Deleuze, *Magazine Littéraire* 325 (1994): 57-65. Yet, lest we forget *Foucault*, a eulogy by Deleuze.

I personally consider Deleuze not so much an original thinker (if there could be any such "original" or even *originative* thinker under the sun) as a superb historian of philosophy. Thus in the epigraph, Foucault sounds wiser when saying "thought is *again* possible" than "*new* thought is possible." A bibliography of Deleuze includes *David Hume* with André Crésson, *La Philosophie critique de Kant*, *Le Bergsonisme*, *Spinoza et le problème de l'expression*, *Le Pli: Leibniz et le baroque* and *Périclès et Verdi: La Philosophie de François Châtelet* (a colleague of Deleuze at Sorbonne and Vincennes). Also, he wrote *less* philosophical commentaries (or rather, *still* philosophical ones on non-philosophers) like *Marcel Proust et les signes*, *Présentation de Sacher-Masoch*, *Kafka* with Félix Guattari and *Francis Bacon*. It is a matter of Deleuzians' choice which book to begin with. Perhaps even more must be decided by certain lovers of Henry Bergson or Marcel Proust, for instance, as to whether they should look into Deleuze; however, I have no doubt that some knowledge of Bergson and Proust will make *Bergson*[*isme*] and *Proust* by Deleuze less obscure (see **3. 1. 4** for the virtual).

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[31] Deleuze and F. Guattari, *A Thousand Plateaus: Capitalism and Schizophrenia* (Minneapolis: University of Minnesota Press, 1987).

[32] Deleuze, *The Logic of Sense* (New York: Columbia University Press, 1990).

2. 1. 1. 1. Stoic ontology

Nothing is deeper in man than his skin. –Paul Valéry[33]

Gilles Deleuze devoted *The Logic of Sense*'s second appendix to Titus Lucretius Carus, a Roman whose *De rerum natura* has been the richest derivative available for Epicureanism because its Greek corpus went missing. Thankfully however, as if having foreseen what should happen, Epicurus (341-271 B.C.) gave summaries in his own correspondence that were handed down by a biographer called Diogenes Laërtius, "to recollect accurately the most fundamental points."[34]

Epicureanism posits: "the universal whole is a body; for our senses bear us witness in every case that bodies have a real existence; and the evidence of the senses [...] ought to be the rule of our reasoning about everything which is not directly perceived."[35] I will cover three phases: first, materialism since Democritus reappears. While praised by Diogenes Laërtius for writing abundantly without references, Epicurus was accused of plagiarizing the Democritean tenets. Let us consider him their adherent.[36]

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[33] *Œuvres, v. II* (Paris: Librairie Gallimard, 1960), 215; translated as *Idée fixe: A Duologue by the Sea* (New York: Pantheon Books, 1965), 31; quoted in Gilles Deleuze, *The Logic of Sense* (New York: Columbia University Press, 1990), 10.

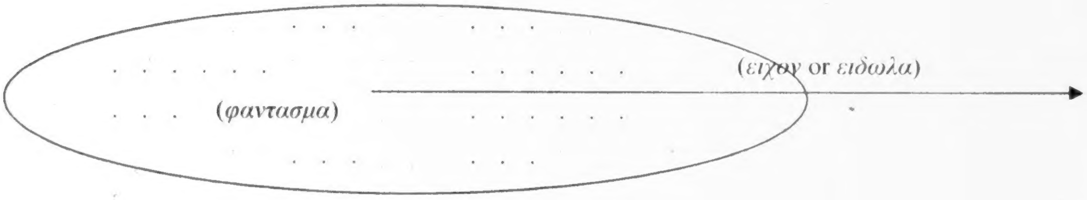
[34] Epicurus, in Diogenes Laërtius, *The Lives and Opinions of Eminent Philosophers*, Book X, http://www.epicurus.info/etexts/Lives.html. Diogenes Laërtius quoted Epicurus unsparingly that I shall assume this last book was co-written.

[35] Epicurus, in Diogenes Laërtius, Book X.

[36] Hermippus, cited in Diogenes Laërtius, Book X.

Secondly and still on physics but henceforth that of communications, those corporeal in-divisibles (*α-τομα*) travel via the air, Epicurus added, "without meeting any obstacle."[37] Along with that, whatever has been also concealed below should climb up through some thickness to play itself out. This notion of "surface effect" denies the Platonic *interior>exterior* hierarchy.[38]

Figure 2. 1. 1. 1-1. Epicurus' conception of release



Third, epistemologically, these very discharges—having once been cast off the object—will stream into our impressions, which are the standards of truth. I argue that Epicurus was the earliest natural philosopher to complete a physiological exposition beyond Democritus, whereby the least particles end up being perceived i.e. exciting our soul as well as body (*σωμα*) which both are composed of atoms; the former seemed implausible otherwise, to Epicureans notably, since ethereality accompanies exclusively the void and meaning (*λεκτον*) or event dynamically generated from matter.[39]

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[37] Epicurus, in Diogenes Laërtius, Book X.

[38] Deleuze, *The Logic of Sense*.

[39] Greek in Diogenes Laertius, *Lives of Eminent Philosophers* (London: William Heinemann Ltd, 1965-66), Book X.

Lucretius re-stated the Epicurean empiricism: "unless this primal faith, deep-founded, fail us not, naught will there be whereunto to appeal on things occult when seeking aught to prove by reasonings of mind." Regarding that micro-theory, he continued: "infallibly a fixed bound remaineth stablished 'gainst their breaking down."[40] Yet, this stoic poet's finest contribution is to my second phase of Epicureanism (Figure 2. 1. 1. 1-1) comparing the five senses. According to him: just because no one faculty can disprove another,[41] not all effluences are equally valid. As we look at something, our vision would reach the outermost non-transparent strata but not much farther; speaking inversely, such ocular coats skirt the boundaries which are pushed forth quickly by the next superficial layer.[42] Lucretius said elsewhere: "all odour, smoke, and heat, and such streams out of things diffusedly, because, whilst coming from the deeps of body forth and rising out, along their bending path they're torn asunder, nor have gateways straight wherethrough to mass themselves and struggle abroad. But contrariwise, when such a tenuous film of outside colour is thrown off, there's naught can rend it, since 'tis placed along the front ready to hand."[43] Thus light would start on the thin surface while other senses inside.

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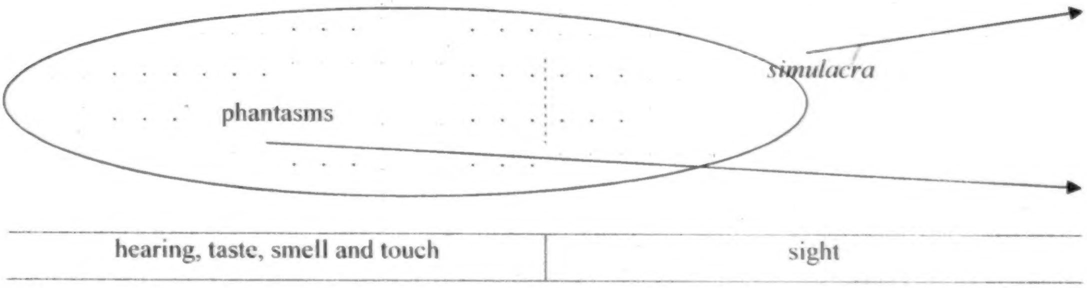
[40] Lucretius, *Of the Nature of Things*, Book I, http://www.gutenberg.org/dirs/etext97/natng10.txt.

[41] Lucretius, Book IV.

[42] Lucretius, Book IV; cf. Epicurus, in Diogenes Laërtius, Book X.

[43] Lucretius, Book IV.

Figure 2. 1. 1. 1-2. Lucretius' dichotomy of sensation[44]



Do those four non-visual forms of data—flavour, odour, touch and hearing—emanate from the same root?[45] I counter with two sensory pairs: first, tasting needs our tongue's licking and teeth's chewing so as to get the stuffing we appreciate out of that lump, whereas the smells from its core simply enter our nostrils.[46] Secondly, although Lucretius seldom mentioned tactility,[47] I am capable of feeling whatever comes in direct contact with me, while sounds penetrate some hard medium, making it vibrate sinuously.[48] Hence taste and touch from each dyad is inserted between crouching phantasms and lofty simulacra (Figure 1-1).

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[44] Latin in http://www.thelatinlibrary.com/luc.html.

[45] Deleuze, *The Logic of Sense*, 266-79.

[46] Lucretius, Book IV.

[47] Maybe because "sight, smell, hearing, and so forth, are just senses of touch" flowing across the inter-atomic space of communication to reach our receptors. "The world is no longer in the distance, it is nearby, tangible." For a different annotation to *De rerum natura*, see Michel Serres, *The Birth of Physics* (Manchester: Clinamen Press, 2000), 107. He cited Karl Marx's doctoral thesis *Differenz der demokritischen und epikureischen Naturphilosophie*.

[48] Lucretius, Book IV.

Let me take responsibility for this further 2+1 scheme, apparently in concert with Deleuze's depth/height/surface which marks the second half of thirty-four series featured in his post-structuralist magnum opus.[49] Consistent mutually are chronological orders thereby of ancient wisdom (e.g. Empedocles thrown deep into a volcano came before Plato high on the clouds or Diogenes)[50] and by Melanie Klein (ego follows id/superego dialectically).[51] Epicureanism shall nevertheless refuse such a twist upon *φαντασμα/ειδωλα*-simulacra (Figure 2. 1. 1. 1-1 & -2). I just wanted to confirm my tripartition of five senses and duly anticipate yet another—critically into phenomenology, French semiology and positivism.

Table 2. 1. 1. 1-1. Logic of *The Logic of Sense*

	depth	surface	height
sages	pre-Socratic (e.g. Heraclitus, Empedocles)	Megarian, cynic (e.g. Diogenes) and Stoic	Platonist
gods	Dionysus	Hercules	Apollo
psychoanalysis	paranoid-schizophrenia, id	oedipal complex, ego	manic-depression, superego
Deleuzian jargons	simulacrum	phantasm	idol

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[49] Deleuze, *The Logic of Sense*; citation henceforth is to series, treated as its own keyword, unless noted otherwise.

[50] Deleuze, *The Logic of Sense*, series 18.

[51] Deleuze, *The Logic of Sense*, series 27 ff.

2. 1. 1. 2. Stoic semantics

> If you say something, it passes through your lips: now you say wagon, consequently a wagon passes through your lips. –Chrysippus[52]

Since language matters to Epicurus, he wrote his disciple: even before the greatest credibility for sensations, "one must determine with exactness the notion comprehended under each separate word, in order to be able to refer to it, as to a certain criterion, the conceptions which emanate from ourselves, the ulterior researches and the difficulties; otherwise the judgment has no foundation. One goes on from demonstration to demonstration *ad infinitum*; or else one gains nothing beyond mere words."[53] According to Titus Lucretius Carus' materialistic verses *De rerum natura*, whatever comes from the larynx must first be pronounced in the mouth for communication as Chrysippus, a veteran Stoic, joked above. Secondly, such human voices represent sounds in general.[54] This enables me to attach a row to the Lucretian model of perception below.

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[52] Quoted in Diogenes Laertius, *Lives of Eminent Philosophers* (London: William Heinemann Ltd, 1965-66), Book VII.

[53] Epicurus, in Diogenes Laërtius, *The Lives and Opinions of Eminent Philosophers*, Book X, http://www.epicurus.info/etexts/Lives.html.

[54] Lucretius, *Of the Nature of Things*, Book IV, http://www.gutenberg.org/dirs/etext97/natng10.txt.

Table 2. 1. 1. 2-1. Senses vis-à-vis linguistic cognition

	depth	surface	height
sensation	(odour) hearing	(taste) touch	sight
language	speech	braille	letter, dactylology

In the eighth book of *Adversus mathematicos* by Sextus Empiricus, this semiotics of Epicureans and Stoics is documented with negative remarks. He did not take issue with their ontological trichotomy, where only the signified *meaning-event* has no corporeality but one side leaning towards its bodily *sound* and external *object*, nor with their belief in "commemorative" signs either leading us into a reminiscence (e.g. the examination of a scar illuminated by the wound that caused it) or being defined "an antecedent proposition in a valid hypothetical major premise, which serves to reveal the consequent" (a cardiac puncture helping prognose her or his death within reach). The sensibility and intelligibility of "indicative" or relative signs of something non-evident, maintained by Dogmatists, was under our Sceptic's attack so I hardly bother with since he admitted: "the non-existence of a sign is equally credible with its existence, or, conversely, that the existence of a sign is equally incredible with its non-existence."[55]

In any case, with the "virtual events to be actual statements" thesis (see **3. 1. 4**), Gilles Deleuze besieged three specific kinds: that of manifestation still presumes the *a*

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[55] Sextus Empiricus, *Against the Logicians* (London: William Heinemann Ltd, 1961), book 2.

priori subject, to whom an object becomes meaningful. Michel Foucault was against Maurice Merleau-Ponty at this point: "*The Logic of Sense* can be read as the most alien book imaginable from *The Phenomenology of Perception*. In this latter text, the body-organism is linked to the world through a network of primal significations which arise from the perception of things."[56] Next, semiologists after Ferdinand de Saussure recognize nothing outside that self-fulfilling, closed structure. Finally, those referents for words to denote are saved by logical positivism which cannot individuate all of them. Chrysippus' wagon is perhaps discrete enough; its "passing" really passes.[57]

Before moving on to a pair of modern-day French stoics (i.e. Bruno Latour and Régis Debray), I will revisit Deleuze's confluence with Foucault that peaked in 1970 when he reviewed *Différence et répétition* and *Logique du sens* while Deleuze answered *L'Archéologie du savoir* reciprocally.[58] Foucault's inaugural lecture at the Collège de France in December sounds fairly Deleuzian to me: "The fundamental notions now imposed upon us are […] of *events* and of *series* […] the philosophy of event should advance in the direction […] of an incorporeal materialism."[59]

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[56] Foucault, "Theatrum Philosophicum," http://www.generation-online.org/p/fpfoucault5.htm. See for what look more compatible (e.g. *Le Visible et l'invisible* and *Différence et répétition*), Erinn Gilson, "Questioning to the Nth Power: Interrogative Ontology in Merleau-Ponty and Deleuze," *Chiasmi International* 6 (2005): 207-24.

[57] Deleuze, *The Logic of Sense* (New York: Columbia University Press, 1990), series 3-5 & 19.

[58] Foucault, "Theatrum Philosophicum"; Deleuze, "A New Archivist," in *Foucault* (Minneapolis: University of Minnesota Press, 1988).

[59] Foucault, "Orders of Discourse," *Social Science Information* 10, no. 2 (1971): 7-30; italicized by me.

Though both works authored the year before share more in common than popularly acknowledged, *Logique du sens* outshone *L'Archéologie du savoir* for their establishing a discussion about *series*. Events happen on the interface between nature and culture. Any physical changes per se (e.g. somebody fell out of a window to the ground) remain in that concrete field; only what has occurred to people becomes significant (e.g. amor fati came true with Deleuze's suicide in November 1995): it has immediately been put into series (n_1, n_2, n_3, …) where each term is given an ordinal value, and every society carries its own Zeitgeist to organize events as such (e.g. without the context of Stoicism, our philosopher's death would merely be scandalous). Foucault called that set of beliefs typical at a unique era "episteme" whose equivalent in Deleuze is "doxa" or common sense/direction—in French, *sens*.[60] This vocabulary surpasses the Foucauldian discourse of episteme in that one doxa seems to be replaced not distinctively by yet another but necessarily by a multilateral "paradox" which guarantees various methods (or possible future doxi) to choose from.

2. 1. 2. Bruno Latour, Régis Debray and Friedrich A. Kittler

> Michel Serres: To take up again the example of Lucretius, contemporary physics at least allows us to reread him, but in an oblique manner, and finally to discover some actuality that is still alive. What do we mean by oblique here? That if you translate atom by atom, you will not get very far. You must look somewhat alongside, or more globally, at the system of turbulence.

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[60] Deleuze, *The Logic of Sense*, series 11-12.

> Bruno Latour: Yes, but to say that this is a time that is still active—this is not a historian's position either. In none of your books do you attempt to "reconstitute the cultural environment of Lucretius," to "seek out the texts he might have read," and thereby utilize history to transport us from our era to that of the Romans. [...] What always interests you is the reverse movement. To take Lucretius, to leap over the philosophers who discount him by saying he's obsolete, and to bring him to the hypotheses that are current in physics.[61]

Michel Foucault's mystic friend at Clermont-Ferrand and Vincennes previously, Serres presented *La Naissance de la physique dans le texte de Lucrèce* eight years after Gilles Deleuze's *Logique du sens* yet before finishing his own five-part *Hermès* [1969-80]—this Greek messenger/trafficker-god[62] must have been summoned to solve the Leibnizian irony of *ars communicandi* among isolated monads. Serres' two protégés seem less angelic or spiritual than himself to me: Latour and Debray,[63] being rather *materialists* both.

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[61] Serres and Latour, *Conversations on Science, Culture, and Time* (Ann Arbor: The University of Michigan Press, 1998), 54.

[62] Similar personae of Serres, traversing and synthesizing academic disciplines whether they are scientific or literary, have followed in his bibliography: e.g. *Le Parasite*, *L'Hermaphrodite* and *Le Tiers-instruit*.

[63] See another Latourian introduction to Serres—who sat on Debray's committee with Daniel Bougnoux, Bernard Bourgeois, Roger Chartier, François Dagognet and Jacques Le Goff being its other members—in *Contemporary French Philosophy*, ed. A. Phillips Griffiths (Cambridge: Cambridge University Press, 1987), 83-98.

2. 1. 2. 1. Neither actor-network theory nor science studies

> This notion of inscription device is sociological by nature. It allows one to describe a whole set of occupations in the laboratory, without being disturbed by the wide variety of their material shapes. [...] Its salient feature is the final production of a figure. –Bruno Latour and Steve Woolgar[64]

Insofar as something has been made flat enough upon a surface we could easily handle from one place to another, it echoes what Gilles Deleuze[65] said; yet Latour, who teamed up with Michel Callon at the Ecole des Mines de Paris to teach graduate-level engineers how inscription[66] and its cultural or scientific content become integrated, seldom gets philosophical. I will deem medical illustration as neither a humanized artefact to which any praxis has been delegated nor "immutable" necessarily once hard imprinted but sheetless and even real-time scanning. Upon categorizing him as stoic,

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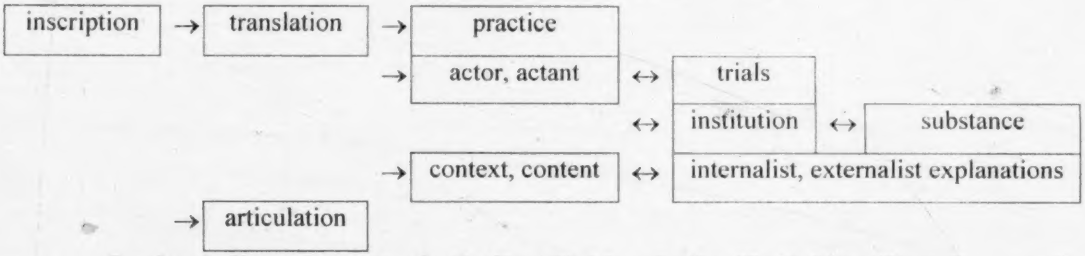
[64] *Laboratory Life: The Social Construction of Scientific Facts* (Beverly Hills: Sage Publications, 1979), 89.

[65] *The Logic of Sense* (New York: Columbia University Press, 1990).

[66] B. Latour's terms are so interdependent one can scroll through—



Pandora's Hope: Essays on the Reality of Science Studies (Cambridge: Harvard University Press, 1999), 303-11 suffice it to say that Latourian quasi-genre of science studies[67] belonged to *sociology of scientific knowledge*; we shall find it has gotten more complicated since the mid-1980s.

2. 1. 2. 2. Mediology?

> *supporting material base*: surface on which traces are inscribed.
> *trace*: any setting down of a record or recording. The minimal object of archiving. –Régis Debray[68]

He defended *Manifestes médiologiques* at Paris I-Sorbonne in January 1994 for his authority to direct research. Eric Rauth or somebody at Verso must have mistaken it for *Manifestes médi*a*logiques* and turned this into *Medi*a *Manifestos* (un-italicized by me). "They may well confuse the function of one form of communicative media with the practice or terms of the mediative act, by reducing the variety of symbolic transmissions to the pale model of telephonic communication," Debray elsewhere anticipates, "Misled by an unfortunate afterglow of sound into reading *media* for *medium*, they even take mediology for a sociology of the *mass media*."[69]

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[67] He used the expression, "as if this discipline exists and is a homogeneous body of work with a single coherent metaphysics," but not without reservations. "It would be an understatement to say that this is far from the case. Most of my colleagues disagree with my portrayal." Latour, *Pandora's Hope*, viii.

[68] This was a Derridian blow to Ferdinand de Saussure's claim for the signifier-signified independence: "Unmotivated, every sign would be unthinkable without a durable institution, that is, without the installation of the *trace*, an 'imprint' that is conserved in a 'space of inscription' [...] writing inflicts language." François Wahl, "Appendix: Toward a Critique of the Sign," in *Encyclopedic Dictionary of the Sciences of Language*, eds. Oswald Ducrot and Tzvetan Todorov (Baltimore: The Johns Hopkins University Press, 1979), 350.

2. 1. 2. 3. Graph vs. gram

> A discourse on discourse is a strange thing to begin. The many traps of tautology and self-reference, so wide open in Paris or Messkirch [sic], wait for another prey. In Latin, however, *discursus* had the precise military meaning of swarming out—a tactical maneuver well suited to avoid traps. Thus, let me swarm out and begin by stating that all discourses are information, but not all information is discourse. This discourse itself may seem of poor or redundant information at Stanford where, from deForest's tube in 1909 up to now, so many steps have been made in electronic data processing. Yet, for literary criticism, the situation is different and a crude statement is useful. –Friedrich A. Kittler

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[69] R. Debray, "The Image v. Language: Transmitting Symbols," *Common Knowledge* 4, no. 2 (1995): 51-69; a partial rendering by Rauth himself of Debray, *Vie et mort de l'image: Une Histoire du regard en Occident* (Paris: Éditions Gallimard, 1992), 45-73. Then why have I quoted *Media Manifestos: On the Technological Transmission of Cultural Forms* (London: Verso, 1996)? "On the one hand, care must be taken not to fall into the pretences of formalism: one does not create a useful concept just by coining a neologism. On the other, a commitment must be made to being precise: no refutability nor even discussion are possible without a definition of terms. The semantic confusion of numerous ongoing debates about 'communication' leads to the conclusion that, of the two, a rudimentary lexicon will always prove a less grievous flaw than a charming rhetorical cloud. All things considered, the social sciences require this basic courtesy." Debray, *Media Manifestos*, 175. He did that in *Manifestes médiologiques*, and Rauth's job upon its glossary is fair.

After this audience-pleasing opener, Kittler from Humboldt University in Berlin continued the lecture[70] with his own English version of "Literatur und Literaturwissenschaft als Word Processing"[71] whose contents sound not much to be on "Foucaultischem Diskurse" (see **6. 2. 2. 2** regarding media archaeology). Whatever he refers to as the *medium* is material[72] whether *gramophone, film, typewriter* [1986] or a higher concept including every technology and institution that would offer (*Angebote*) such products.[73] Kittler's veering, for instance, towards *Optische Medien*[74] does not escape my notice. Bruno Latour too has proceeded from textual inscriptions to drawn evidence.[75] Do they remind us of mediological belligerency on *la sémiologie*?[76]

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[70] F. Kittler, "A Discourse on Discourse," *Stanford Literature Review* 3 (1986): 157-66.

[71] In *Germanistik: Forschungstand und Perspektiven, v. 2*, ed. Georg Stötzel (Berlin: Walter de Gruyter, 1985). Kittler's early Goethean works are comparable to Bernhard Siegert, *Relays: Literature as an Epoch of the Postal System* (Stanford: Stanford University Press, 1999).

[72] Geoffrey Winthrop-Young and Michael Wutz titled *Configurations* 10, no. 1 as *Media, Materiality, Memory* featuring Kittler; if Régis Debray had contributed, *Mediation*—access to something else—should have replaced *Media* there. See also Hans Ulrich Gumbrecht and Karl Ludwig Pfeiffer, eds. *Materialities of Communication* (Stanford: Stanford University Press, 1994).

[73] Siegfried J. Schmidt, *Kognitive Autonomie und soziale Orientierung: Konstruktivistische Bemerkungen zum Zusammenhang von Kognition, Kommunikation, Medien und Kultur* (Frankfurt am Main: Suhrkamp, 1994), 322.

[74] Regrettably no English rendering yet; some translations of him are hidden, e.g. five chapters from *Draculas Vermächtnis* in Kittler, *Literature, Media, Information Systems* (Amsterdam: G+B Arts International, 1997). John Johnston could have edited it otherwise.

[75] B. Latour, "Visualization and Cognition," in *Knowledge and Society: Studies in the Sociology of Culture Past and Present, Volume 6*, eds. Henrika Kuklick and Elizabeth Long (Greenwich: JAI Press Inc, 1986).

A favourite reference for the graph/gram dichotomy would be *Le Geste et la parole* by André Leroi-Gourhan whose concepts Jacques Derrida quotes, including that of inscription.[77] Earlier in March 1937, the *British Medical Journal*'s editors replied to R. Boulton Myles positively: "It is our practice to use the word radiograph in preference to radiogram, which is now in general use either for a message transmitted by wireless telegraphy or for a combination of a wireless set and a gramophone. The *Oxford English Dictionary* defines radiograph in this context as 'an impression or image of an object produced on a sensitive plate by means of the Röntgen rays'."

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[76] Régis Debray, "The Image v. Language: Transmitting Symbols," *Common Knowledge* 4, no. 2 (1995): 51-69.

[77] J. Derrida, *Of Grammatology* (Baltimore: The Johns Hopkins University Press, 1976), 83-87.

2. 2. Visual and linguistic communication (1)—in the history of medicine[78]

> In medical training you are accustomed to see things. You see an anatomical preparation. […] Later on, patients are demonstrated before your senses—the symptoms of their illness. […] In psycho-analysis, alas, everything is different. Nothing takes place […] but an interchange of words between the patient and the analyst. The patient talks, tells of his past experiences and present impressions, complains, confesses to his wishes and his emotional impulses. –Sigmund Freud[79]

What follows is a preliminary study of the major sem(e)iotic literature to reinvestigate the history of Western medicine from a position of *communication*—whatever is meant by that here as the introduction. Freud gave me an insight although it is not my intention to verify his vow quoted above—especially about psychoanalysis. For now, I contend that communication of any sort does not guarantee equality, let alone a shift, between the addresser and the addressee.

As to a (pre-)clinical milieu, we could improvise a two-by-two table—visual/linguistic and physician/patient—but not fill in all four cells symmetrically. Therefore, the first variable asking "which communication has been superior?" mingles with the second "for the sake of whom"—the doctor or his *case*?[80] Thanks to Thure von

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[78] Published in *Visio* 8 (2003): 275-83; correctly reprinted by permission with **2. 2. 1** replaced by a Canadian Communication Association presentation, May 2002.

[79] *The Standard Edition of the Complete Psychological Works of Sigmund Freud, v. XV: Introductory Lectures on Psycho-analysis* (London: The Hogarth Press, 1961), 16-17.

[80] David Mintz, "What's in a Word: The Distancing Function of Language in Medicine," *Journal of Medical Humanities* 13 (1992): 223-33.

Uexküll, two versions of medical semiotics have already been offered—the one *in* medicine and the other *of* medicine ranging from human interaction to ethics.[81] I would like to carry on just one step further—to the semiotics of pain.

2. 2. 1. How the Hippocratic writer(s) dealt with the *Other*

> Life is short, the art (*τεχνη*) long [...]

Hippocrates' opening aphorism sounds appealing rhetorically. Urged around 2400 years ago, it has persisted in circulation although swerving away from the ensuing context of emergency where somebody was dying or of non-aesthetic, time-consuming surgery (*ιητρειον*), due perhaps to its concise style and verbatim memorability:

> [...] opportunity fleeting, experiment treacherous, judgment (*κρισις*) difficult. The physician must be ready, not only to do his duty himself, but also to secure the co-operation of the patient, of the attendants and of externals.[82]

My discussion is about the success and failure of the Hippocratic tradition—especially, how it had acquired an early monopoly and maintained prestige, from which modern medicine stems, impurely because ironically it is scientific. Whether or not accepting fictitious incidents such as Hippocrates of Cos having burned his rival library at Cnidos down,[83] we shall concentrate on the contents of the Hippocratic thought per se that are guided by a more delicate appreciation than Edward W. Said's dichotomy of "the Orient vs. the Occident."[84]

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[81] T. von Uexküll, "Semiotics and Medicine," *Semiotica* 38, no. 3/4 (1982): 205-15.

[82] Hippocrates, *Aphorisms* (London: William Heinemann, 1967), section 1, proposition 1.

When it comes to Hippocratic works, Émile Littré collected up to seventy, which are dated 450~350 B.C. at the narrowest.[85] Some of them must not have been composed by Hippocrates the Coan alone. Therefore, the *Corpus* as a whole à la Hippocrates has undergone philological tests: for example, Galen the Roman commentator never spoke of *Ancient medicine* yet Francis Adams selected it for inclusion.[86] Since this paper is regretfully not based upon the raw manuscripts in Ionic, their grammatical cohesion as one of several criteria for textuality[87] remains unconfirmed. However, having perused some excerpts, I would point out a few implications for communication history, which can be summarized as:

> 1) sem(e)iotics: interpreting signs of illness and, with the bracketed "e" deleted, of anything—*aliquid pro aliquo*.

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[83] Jacques Jouanna, *Hippocrates* (Baltimore: The Johns Hopkins University Press, 1999), 26-28.

[84] E. Said, *Orientalism* (New York: Vintage Books, 1978).

[85] É. Littré trans., *Oeuvres complètes d'Hippocrate, v. I-X* (Amsterdam: Adolf M. Hakkert, 1973-82).

[86] F. Adams trans., *The Genuine Works of Hippocrates, v. 1* (London: Sydenham Society, 1849); see also David Cantor, ed., *Reinventing Hippocrates* (Aldershot: Ashgate, 2002).

[87] R.-A. de Beaugrande and W. U. Dressler, *Introduction to Text Linguistics* (London: Longman, 1981).

2) sociology in/of medicine, or unequal doctor-patient relationship: the former observes and instructs the latter.

3) cultural and political geography vis-à-vis that of Herodotus: argumentative semiosis needed three dimensions, having exhausted the chronological one unsatisfactorily.

2. 2. 1. 1. The father of … symptomatology

> I hold that it is an excellent thing for a physician to practise forecasting. For if he discover and declare unaided by the side of his patients the present, the past and the future, and fill in the gaps in the account given by the sick, he will be the more believed to understand the cases, so that men will confidently entrust themselves to him for treatment.[88]

Hippocrates proceeded to enumerate dangerous signs. For him, in examining those manifestations on the eyes (e.g. hollow, squint, restless, light-shunning, involuntarily weeping, the whites being red, livid or with black veins) and the face (discoloration, sharp nose, protruding lobes, bent or loose lips, rough or parched forehead), seeing is believing.

Hippocrates' oculocentric attitude was typical of that age. To some Grecians, living corresponds with looking: Oedipus blinded himself.[89] Herodotus recorded as he heard it that Candaules the Lydian King had advised Gyges, "men trust their ears less than their eyes; […] you may see [my wife] naked." This voyeuristic proposal led to an assassination, committed by the bodyguard and the Queen, to usurp the sovereign.[90]

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[88] Hippocrates, *Prognostic* (London: William Heinemann, 1959), chapter 1.

[89] R. Debray, *Vie et mort de l'image: Une histoire du regard en Occident* (Paris: Éditions Gallimard, 1992), 19.

So much for seeing; saying is different. A good medic could persuade his bedridden friends in person—or, visit them with an orator, another kind of craftsman[91]—*to secure their co-operation*. However, as the aphorism goes: *life is short, the art long*. Not obliged to consult the rest of those participants, a doctor conceals "most things from the patient"[92] who should be obedient enough not to initiate a question against the paternalistic order—*most things* except prompt reminders of what the interviewee forgot to complain of.

Certain sophists asserted that a remedy even resembles an ache and is "worth while to endure" for adults.[93] One may thereupon gather the Hippocratic task was not verbally alleviating care. Still rather than to cure mortals at the risk of his reputation, Hippocrates chose to predict defensively who were about to expire or survive, "at least to do no harm."[94] How ethical Hippocrates was![95] Although these sages were able to learn quite a few qualities of malady, their exercises are insufficient from the standards of our millennium.

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[90] Herodotus, *The Histories*, http://www.perseus.tufts.edu, book 1. chapter 8; see also Plato, *Republic*, http://www.perseus.tufts.edu, Stephanus page 359 ff.

[91] Plato, *Gorgias*, http://www.perseus.tufts.edu, 456b. Herodicus, tutor to Hippocrates, accompanied his own brother Gorgias.

[92] Hippocrates, *Decorum* (London: William Heinemann, 1959), chapter 16; genuineness of this treatise has been in doubt.

[93] Plato, *Gorgias*, 478b-c.

[94] Hippocrates, *Epidemics* (London: William Heinemann, 1972), book 1. paragraph 11.

[95] Reciprocal decision-making is not spelled out in *The Oath* (London: William Heinemann, 1972); see also Abraham Moles, "Pour une révision du serment d'Hippocrate: Vers une nouvelle dimension sociale du contrat médical," *Prospective et Sante* 12 (1979): 9-18.

2. 2. 1. 2. Quackery or hypothesis?

Praised for an advance from superstition to natural law, did Hippocrates carry out reasoning superior to the charlatans' incantations he condemned?[96] Yes, but I consider it not exactly inductive. Hippocrates accumulated data; he rarely classified many of them (i.e. diagnosis) and labelled each syndrome quickly (nosography). As disputed in a review of the Cnidian school, that is far from extraction: "the number will be almost incalculable if a patient's disease be diagnosed as different whenever there is a difference in the symptoms."[97] Little essential hides behind discernible signs and, interestingly, this superficiality supports the authenticity of Hippocrates' core pieces where concern over what might draw near (prognosis) was preferred.

Indeed, this hypothetico-deductive mode continues to prevail in contemporary settings (see **5. 1. 3**). To bother about a sequential subtlety,[98] I ought to separate post-Galenic pupils adopting a nomenclature (e.g. *Diagnostic and Statistical Manual*) in anticipation of the concrete from Hippocrates who invented a regularity out of visual curiosities. His *modus operandi* is a quasi-combination of induction and deduction. Having observed a few signs, Hippocrates dared to postulate a diachronic course, wherein the fact that he omitted any named diseases is remarkable. Such a plausible course was to be verified through events which happen to the individual in hand and, furthermore, to everybody without frontiers.

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[96] Hippocrates, *The Sacred Disease* (London: William Heinemann, 1959), chapter 2.

[97] *Regimen in Acute Diseases* (London: William Heinemann, 1959), chapter 3.

[98] U. Eco, "Horns, Hooves, Insteps: Some Hypotheses on Three Types of Abduction," in *The Sign of Three: Dupin, Holmes, Peirce*, eds. U. Eco and T. A. Sebeok (Bloomington: Indiana University Press, 1983), 206-7.

2. 2. 1. 3. Hippocratic space(s): one for all, all for one

Shall we blame Hippocrates for cunning? Granting he denied shamanistic therapy and dispensed with helpful measures excluding nutrition or homoeopathy (*similia similibus curantur*) let me move on to the question of etiology. Throughout documents in *Epidemics* (chiefly Books 1 & 3), which seriously lacks textual coherence,[99] the probability of infection is surprisingly missing.[100] Hippocrates, to whom authorship has obviously credited,[101] would here conceive of vital systems as being twice isolated: they neither interact with the surroundings nor are under the neural control. Whereas sorcerers had warned humans of Hecate the sinister possessor's attack (i.e. *pavor nocturnus* during deep slow-wave sleep), Hippocrates did not refer to the mythical realm. His investigation reaches across geographic borders instead, and he derived broader justifications: "one must clearly realize about sure signs and about symptoms generally, that in every year and in every land bad signs indicate something bad, and good signs something favourable, since the symptoms described above prove to have the same significance in Libya, in Delos, and in Scythia."[102]

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[99] H. Vater, *Einführung in die Textlinguistik: Struktur, Thema und Referenz in Texten, 2. Auflage* (München: Wilhelm Fink Verlag, 1994), 65.

[100] Hippocrates, *Breaths* (London: William Heinemann, 1959), chapter 6; a slightly minor lecture delivered.

Extrapolation like this is never motivated by pan-philanthropy. On the contrary, legend has it that patriotic Hippocrates declined to assist the imperial army under Artaxerxes' command as they were suffering from a plague[103]; however, being ignorant of those contagious sources, who could really rescue miserable Athens in his era? Passively *not to do wrong*, or preoccupied with death,[104] Hippocrates and colleagues would compare morbid demonstrations shown in one community with those spread elsewhere merely to exercise their blasé contemplation (*θεωριη*) of ubiquitous validity, i.e. a stable prognosis whether it is hot, temperate, cold.

Hippocrates recognized the world as heterogeneous. He claimed respective climates affect the exotic landscape and their organisms. In mild Asia located "midway between the risings of the sun," everything from her vegetation to inhabitants is

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[101] P. Potter, *Short Handbook of Hippocratic Medicine* (Québec: Les Éditions du Sphinx, 1988), 13-14.

[102] Hippocrates, *Prognostic* (London: William Heinemann, 1959), chapter 25.

[103] *Pseudepigraphic Writings: Letters—Embassy—Speech from the Altar—Decree* (Leiden: E. J. Brill, 1990), letters 1-9; see also Thucydides, *History of the Peloponnesian War* (London: William Heinemann, 1956), book 2, chapters 47-54.

[104] Faulted by Asclepiades of Bithynia; quoted in Galen, "On Venesection against Erasistratus," in *On Bloodletting: A Study of the Origins, Development and Validity of His Opinions, with a Translation of the Three Works* (Cambridge University Press, 1986), Kühn page XI, 163.

magnificent in beauty and size.[105] Conversely, in other latitudes, they become spiritually weak. Apropos of this, he inferred the subjugating government to comprise a supplementary variable: "where men are not their own masters and independent, but are ruled by despots, they are not keen on military efficiency."[106] We find an Orientalist *déjà vu* with its exquisite touch: it shares striking parallels with Herodotus' stereotype of unprecedented Ethiopians, the finest who reportedly elected a tall and proportionally vigorous villager their chieftain.[107]

Hippocrates, a contemporary of Herodotus, may well have wandered to many towns by professional request where field-research used to be run within limits; yet, he travelled a lesser distance than his testimony encompasses. To portray the wild Scythians residing at a rugged and infertile northbound region, previously "Europe," in proximity to Lake Maeotis which Hippocrates never explored, racially filtered prejudice aroused sexual fantasies: there were for Hippocrates trans-corporeal heroines (i.e. amazons) with a bow or spear: "while [the girls] are yet babies their mothers make red-hot a bronze instrument constructed for this [belligerent] purpose and apply it to the right breast and cauterise it, so that its growth is arrested, and all its strength and bulk are diverted to the right shoulder and right arm."[108]

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[105] Hippocrates, *Airs Waters Places* (London: William Heinemann, 1972), chapter 12.

[106] Hippocrates, *Airs Waters Places*, 16.

[107] Herodotus the Halicarnassian travelled widely, though seldom so remotely as the sub-Saharan area, utilizing crude maps from the bird's-eye-view in line with the tenet of continental symmetry. By such maps, he grasped the shape of the terrain to steer challengingly. His inquiry (*ιστοριη*) teems with digressions indirectly relevant to the War of that time. I could summarize it into a single affair of the Persian conquest which eventually leads towards a moral conclusion. Herodotus in Book 1 *stopped the flow* to introduce every country equally as promised along Persia's violent path, and assigned the pivotal status to the episode of Lydian collapse: this is how East met West according to Herodotus, *The Histories*, http://www.perseus.tufts.edu.

A bizarre abnormality in the venery "Enareis" annihilated the Scythians; are we aware of their descendants today? Sticking to mysticism, Herodotus insisted some deserters had destroyed Aphrodite's temple in the Syrian city of Ascalon and that her wrath castrated them.[109] To invite with dignity our soul to heaven as doomed (*θανατος*) is a masculine job; she and her daughters bother to kill ultimately.[110] For this very occasion of impotence which forced those who had blasphemed to become extinct, Hippocrates offered a sensible explanation: "The men have no great desire for intercourse because of the moistness of their constitution and the softness and chill of their abdomen [...] Moreover, the constant jolting on their horses unfits them for intercourse [...] For neither is their [women's] monthly purging as it should be, but scanty and late, while the mouth of the womb is closed by fat and does not admit the seed."[111]

2. 2. 1. 4. Beyond "us/them"

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[108] Hippocrates, *Airs Waters Places*, 17.

[109] Herodotus, 1. 105; see also F. Hartog, *The Mirror of Herodotus: The Representation of the Other in the Writing of History* (Berkeley: University of California Press, 1988).

[110] J.-P. Vernant, "Feminine Figures of Death in Greece," *Diacritics* 16 (1986): 54-56.

[111] Hippocrates, *Airs Waters Places*, 21.

Medicine by Hippocrates is triadic—consisting of the physician, the patient proper[112] and the affliction to be probed. Ideal conditions permitted, two members at these encounters fight the unwelcome party. Hippocrates needed the valiant but soon ailing foreigners, in addition to what was actually witnessed, through environmental determinism. Hence, those who suffer and what they unpleasantly experience bear confusion via the mediation of their custom. Still, all these thirds' effeminacy remains unchanged.

Let me suggest a cautious but inspirational affinity with a hoary legacy for communication. When people talk, the enunciating subject, appropriating a *langue*, declares himself as the pronoun "I" then sets in front of him another to whom he utters the dative "you" and who echoes "you" to him vice versa. How about the non-personal "it"?[113] Supposing "we" pursue a mutually agreeable goal enabled by the Socratic skill of dia(2)lectic, "I" with "you" presume a common enemy that is hidden[114] but we struggle to expel interference from "our" arena of civilization. The radical *Other*, as "her," abided likewise before and after Hippocrates.

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[112] See, for Plato's three hierarchical groups—the free and rich, the free yet poor, slaves—P. Lain Entralgo, *Doctor and Patient* (New York: McGraw-Hill Book Company, 1969), 29-41.

[113] Émile Benveniste, *Problems in General Linguistics* (Coral Gables: University of Miami Press, 1971), 221-26.

[114] For *noise at bottom* prior to that message, see M. Serres, *Hermes: Literature, Science, Philosophy* (Baltimore: The Johns Hopkins University Press, 1982), 65-70.

2. 2. 2. John Locke's longing for communication: impossible?

> [C]ommunication is an enigma, even a wonder. [...] By solitude [...] what is experienced by one person cannot be transferred whole as such and such experience to someone else [...] nevertheless, something passes from me to you.
>
> –Paul Ricoeur[115]

It was Locke who coined the hopeful notion of the English term "communication" to which we are bound today—the sharing of *idea* among people and, from that, resulting in their *ideal*. According to Locke, externally sensible marks like words stand for—merely substitute—thoughts one derives from worldly objects; and the ideas interposed between things and names[116] by the collectively agreed contract are transmitted for "the Comfort of Society."[117] Here, to my regret, this explicit founder of semiotics confused two stages of sign (Figure 2. 2. 2-1): is his "idea" to a thing exactly what a word is to the idea?

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[115] *Interpretation Theory: Discourse and the Surplus of Meaning* (Fort Worth: The Texas Christian University Press, 1976), 15-16.

[116] Plato, *Cratylus*, http://www.perseus.tufts.edu, 436b.

[117] J. Locke, *An Essay Concerning Human Understanding*, http://www.ilt.columbia.edu/publications/locke_understanding.html, Book III. Chapter 2.

Figure 2. 2. 2-1. Double signification in Locke's semiotics

thing →	idea →	word
	: sign of thing	: sign of idea
		: metasign (= sign of sign) of thing

Locke deemed, besides, the interior self's experience is owned privately *and* sent to another mind in mysterious ways. This is how, in Locke, epistemological solipsism merged momentously with political liberalism defending the inviolable freedom of the individual—the outstanding child of modern times. In this regard, while such pre-Enlightenment etymologies as "*communicatio*" and "*communis*" in the humanities should be declined,[118] that which used to designate physical "*actio in distans*" since the 17th century is noteworthy. Of the British empiricists, Sir Isaac Newton stated that the rays are not coloured where "there is nothing else than a certain Power and Disposition to stir up a Sensation of this or that Colour."[119] My mental *image* of "redness" might hence normally coincide with your "yellowness" or whatever; the light-stimulus emanating from the "red" surface is of the similar wavelength (620-700nm). In comparison, because bodily pain which the International Association for the Study of Pain defined as "an unpleasant sensory and emotional *experience* associated with actual or potential tissue damage, or described in terms of such damage"[120] is introspective indeed to the sufferer, the measurement of painful stimulus would reveal scarcely other attributes than psychophysical severity.

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[118] John Durham Peters, "John Locke, the Individual, and the Origin of Communication," *Quarterly Journal of Speech* 75 (1989): 399n.

[119] I. Newton, *Opticks or a Treatise of the Reflections, Refractions, Inflections & Colours of Light* (New York: Dover Publications, 1952), Book I. Part II. Proposition II.

It is not so convenient to obtain semeiotic *instructions* from Locke; the *implications* are enough. Locke's "sem(e)iotike" was tied to the medieval "*aliquid pro aliquo*": something can be a sign of something else. Thereafter, intellectual faux pas have arisen: for example, a thought which deals with a sign being itself a sign, and a man who thinks with a sign being himself the thought and the sign.[121] This is a paradoxically beneficial legacy without which my own inquiry could not be appended to the two-by-two typology: if, by any predominant channel of communication, whoever has become master, then master of *what*? Or, to put it otherwise: what is *signified*—either abnormality[122] or irremissible suffering?[123]

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[120] IASP Subcommittee on Taxonomy, "Pain Terms: A List with Definitions and Notes on Usage," *Pain* 6 (1979): 250; italicized by me.

[121] Charles Sanders Peirce, *Collected Papers* (Cambridge: Harvard University Press, 1931-35 & 1958), Volume V. paragraphs 283 & 314.

[122] Georges Canguilhem, *The Normal and the Pathological* (New York: Zone Books, 1991).

[123] Emmanuel Lévinas, *Time and the Other* (Pittsburgh: Duquesne University Press, 1987), 69.

2. 2. 3. Charles Sanders Peirce's "qualisign" to be embodied?

> [I]f the sign were not related to its object except by the mind thinking of them separately, it would not fulfill the function of a sign at all. Supposing, then, the relation of the sign to its object does not lie in a mental association, there must be a direct dual relation of the sign to its object independent of the mind using the sign. [...] Of this nature are all natural signs and physical symptoms. I call such a sign an *index*, a pointing finger being the type of the class.[124]

Peirce divided signs by three trichotomies to yield ten (${}_3H_3={}_{3+3-1}C_3=5*4*3/3*2$) classes systematically (see Table 4. 2. 3-1). Let me start with his "most fundamental" classification—the second trichotomy. An index represents something different from itself—functionally at least: in medical semiotics, we should thus have a group of symptoms *and* a disorder of health—apart. Speaking of pain, the wound belongs to indices "by physical connection."[125] By this I mean that the wound is not equal to pain although they are linked non-arbitrarily. Therefore, as the initial objective estimate of subjective pain, a direct observation seriously lacks methodological validity: in such a manner, does the physician measure the patient's *experience* of pain? All we do is to guess from bodily changes either following or being followed by pain.

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[124] *Collected Papers of Charles Sanders Peirce* (Cambridge: Harvard University Press, 1931-35 & 1958), Volume III, paragraph 361; italicized by me (citation is to *CP* Volume. paragraph).

[125] *CP* II. 274-82.

Table 2. 2. 3-1. Trichotomies of sign

	firstness—possibility	secondness—existent	thirdness—law
first trichotomy: the representamen in itself	qualisign: a quality which is a sign	sinsign: an actual existent thing or event	legisign: a law, usually established by men
second trichotomy: the representamen in relation to its object	icon: a sign which refers to the object by virtue of some characters of its own	index: by virtue of being really affected by that object	symbol: by virtue of a law, usually an association of general ideas
third trichotomy: the representamen as interpreted	rheme, including term	dicisign or dicent sign, including proposition	argument

For the first trichotomy, Peirce assigned the symptom in general to a legisign whereas he did its specific occurrence to a sinsign.[126] What sounds more remarkable to me is the way in which he presented a qualisign contrary to other classes which are necessarily *of* something: "qualities are whatever they are independently of anything else."[127] Granting that "a feeling of 'red'" is a qualisign, a painful experience would be another. However, a qualisign (possibly *as* pain) is contradictory per se for "[i]t cannot actually act as a sign until it is embodied"[128] and Peirce did not uncover how it could ever be.

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[126] *CP* VIII. 335.

[127] *CP* II. 248.

[128] *CP* II. 244.

Guided by the last trichotomy, I might attempt to consider some of the nine classes left over as signs *of* pain: a few sorts of rhematic—"spontaneous" cries ("ouch"), demonstrative pronouns ("this" or "that" pain), its names ("migraine")—and perhaps dicent sign ("That hurts") as well.[129] In particular, a rheme is neither true nor false.[130] Moreover, succeeding William James who was as responsible as Peirce for New England pragmatism, Andrew C. Papanicolaou maintained that all conscious experiences are to the person concerned infallible in themselves: "True, because I did have it and while having it I need no other warrant of its reality," regardless of the outward stimuli—or internal ones in case of visceral pain. Papanicolaou set forth instead a test of *veridicality* for which nonetheless what we perceive non-geometrically such as colour, pitch, taste, smell and pain can rarely be asked whether it matches the characteristics of the external world or not.[131]

It has been proven the old Peirce's (circa 1903) input-oriented "semiotic"—from sensation to interpretation—did not address inter-personal conversations. In medical circumstances, a patient is shown to her physician by nonverbal means through which information on sickly conditions flows unilaterally. Now, pain that one undergoes is not apparent; rather, as a response in the intra-personal context, it plays a protective role—warning the central nervous system against "actual or potential tissue damage"—in order to minimize such a peril.[132] Yet this behaviorist approach[133] ignores something I cannot leave aside. Here is the contradiction: most of us are familiar—to a diverse extent though—with what it feels like to be in physical pain, but nobody else is allowed to suffer for me or with me, and the exemption would seldom come as simply as hoped for. Be this called "communication" or whatever, I who ache have to express it first and others ought to listen.

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[129] *CP* II. 254-64.

[130] *CP* VIII. 337.

[131] A. Papanicolaou, *Emotion: A Reconsideration of the Somatic Theory* (New York: Gordon and Breach, 1989).

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[132] Ivan Polunin, "The Body as an Indicator of Health and Disease," in *The Anthropology of the Body*, ed. John Blacking (London: Academic Press, 1977).

[133] Charles W. Morris, *Writings on the General Theory of Signs* (The Hague: Mouton, 1971).

2. 2. 4. Louis Hjelmslev's "content-purport" to be "formed"?

> Without language, thought is a vague, uncharted nebula. There are no pre-existing ideas, and nothing is distinct before the appearance of language. … Phonic substance is neither more fixed nor more rigid than thought; it is not a mold into which thought must of necessity fit but a plastic substance divided in turn into distinct parts to furnish the signifiers needed by thought. The linguistic fact can therefore be pictured in its totality—i.e. language—as a series of contiguous subdivisions marked off on both the indefinite plane of jumbled ideas and the equally vague plane of sounds … language works out its units while taking shape between two shapeless masses … *their combination produces a form, not a substance*. –Ferdinand de Saussure[134]

Concluding that the linguistic view taught by de Saussure is "appropriate," Hjelmslev managed to explain how a sign *functions*—"generated by the connexion between an expression [signifier] and a content [signified]."[135] He added, however, another variable called "purport" (from "mening" in Danish) to Saussure's "form and substance" in the expression and content planes as well: a purport is the "amorphous continuum" in common to all languages that must nonetheless be *articulated* by a form differently; a form is the abstract "structural principle" so peculiar to each language (in French "langue") that it lays "arbitrary" boundaries on the purport-continuum; a linguistic substance must thus be shaped, by presuming its form. Hence de Saussure's amorphous substance would correspond to Hjelmslev's purport in lieu of his already *formed* substance. The same mechanism is supposed to be applicable to both sides contracting the function.[136]

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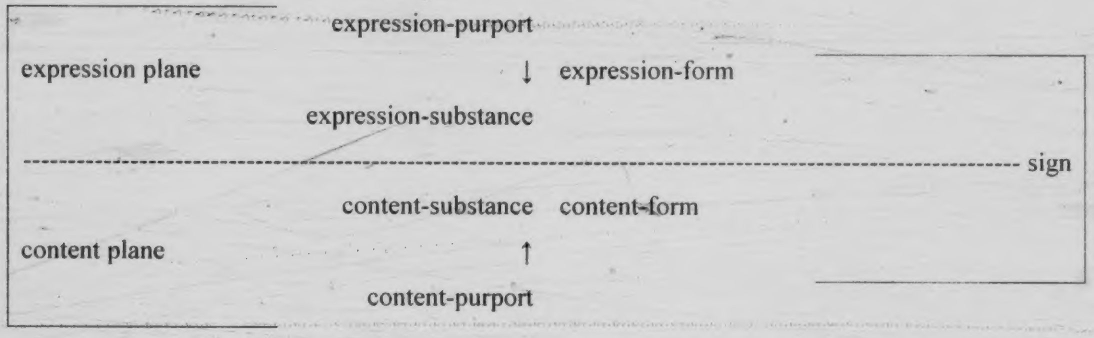
[134] *Course in General Linguistics* (New York: Philosophical Library, 1959), 112-13.

[135] L. Hjelmslev, *Prolegomena to a Theory of Language* (Madison: The University of Wisconsin Press, 1961), 47.

Figure 2. 2. 4-1. Bifacial and triplex diagram of sign function



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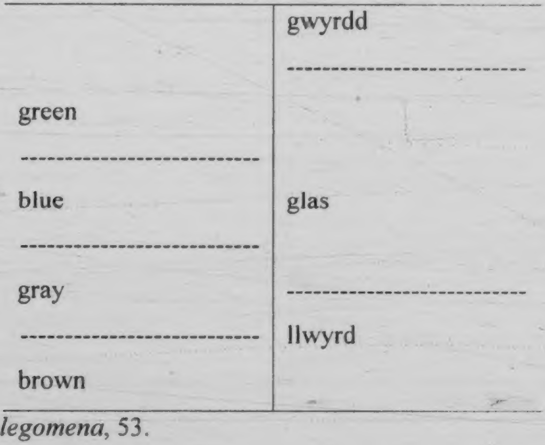
[136] If we annotate the most famous illustration of colour spectrum by Hjelmslev, the vertical axis matches a content-purport; segmented by the horizontal systems respectively in English and in Welsh, that is, linguistic forms; and the consequent designations such as "gwyrdd" and "brown" are substances.



Hjelmslev, *Prolegomena*, 53.

My perusal of Hjelmslev may not be orthodox since I regard a purport as no less important than, on both semiotic planes, the other dyadic levels—a form and a substance. Purport is what Hjelmslev proposed on purpose, not being satisfied with de Saussure's form exceeding substance, paradoxically to emphasize its removal from his *immanentist* "glossematics": according to Hjelmslev, linguistics instead "can and must" analyze the form "without considering the purport [...] in both planes."[137] The concept of "mening," nevertheless, has evoked some nuisances.[138] Thereupon in translations by others, I have found no better equivalent than "matière ou sens": for instance, Julia Kristeva accused Hjelmslev of presupposing "meaning."[139] Umberto Eco used "the *matter*, the *continuum*" more willingly than "purport."[140] Though it was said to become knowledgeable only through formation, such a relative definition as "anything that has not been formed yet," is hardly acceptable.[141]

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[137] Hjelmslev, *Prolegomena*, 78.

[138] One of them was revealed in an indecisive fashion by his own French writing: "Pour désigner la manifestante sans impliquer qu'elle soit sémiotiquement formée, c'est-à-dire sans distinguer manifestante sémiotiquement formée et manifestante sémiotiquement non-formée, ce qui est une notion entièrement différente, nous proposons le terme *matière* (continued in footnote) [O]u *sens*." Hjelmslev, *Essais linguistiques* (Paris: Éditions de Minuit, 1971), 58.

[139] J. Kristeva, *Revolution in Poetic Language* (New York: Columbia University Press, 1984), 38-42; "sens" in French, *La Révolution du langage poétique* (Paris: Éditions du Seuil, 1974), 37-41; originally, "mening."

[140] U. Eco, *Semiotics and the Philosophy of Language* (New York: The Macmillan Press, 1984), 44-45.

[141] Hjelmslev, *Prolegomena*, 76.

2. 2. 5. Roland Barthes' medical language as the "universal interpreter"?

> Patient: Sometimes I wish there *was* something [wrong] [...] So we could work on something, a particular problem. If it is my hormones, correct it, a chemical imbalance ... find something specific. My pituitary. A vein, or vessels are too small? Widen it.[142]

It was Barthes who, in his commentary on *Naissance de la clinique* by Michel Foucault, adapted Louis Hjelmslev's framework. Barthes, like Foucault at first glance, differentiated two strata of signifiers—a symptom equated with the substance and a medical sign with the form. However, as Hjelmslev updated Ferdinand de Saussure's pair, we could do so with Barthes's "semiology": a symptom "as matter which has not yet been segmented into signifying units" being the expression-purport and an accessible sign the expression-substance.[143] The physician's consciousness trans*forms* the symptom into a sign; it had been so in the 18th century while, in Foucault the archaeologist, the symptom got replaced with the sign later in anatomico-clinical medicine (Figure 2. 2. 5-1). Admitting such discontinuity in the history of occidental medicine, I would point out the millennial primacy bestowed on "the eye that governs."[144] With the stethoscope,

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[142] Cited in Jean Jackson, "Chronic Pain and the Tension between the Body as Subject and Object," in *Embodiment and Experience: The Existential Ground of Culture and Self*, ed. Thomas J. Csordas (Cambridge: University of Cambridge Press, 1994), 212.

[143] R. Barthes, "Sémiologie et médicine," in *Œuvres complètes, t. IV* (Paris: Éditions du Seuil, 2002); translated in *The Semiotic Challenge* (Oxford: Basil Blackwell, 1988), 205.

[144] M. Foucault, *The Birth of the Clinic: An Archaeology of Medical Perception* (New York: Pantheon Books, 1973), 89.

Foucault's "positive gaze" became auditory and tactile; did it speak too? Barthes's "language" was unrestrained, but here it comes precisely after diagnosis finishes and nosography starts: a disease is named and the name signifies conversely the symptoms,[145] whose collection—not articulation—has just been associated with the very disease and beyond which "there is no longer a pathological essence,"[146] and the signs which by nature would be identified with the symptoms.

Figure 2. 2. 5-1. Model drawn after Hjelmslev's of proto- and post-clinic diagnoses

expression-purport	symptom			
expression-form	↓	physician's sight		← sensory integration
expression-substance	sign		sign	
content-substance	seat		lesion	
content-form	↑	localization	↓	detour
content-purport	disease		disease	

In fact, Francis G. Crookshank as well, using Charles Kay Ogden and Ivor Armstrong Richard's triad, had accurately elucidated what Barthes did: a deviant manifestation is "at once" recognized by the patient (a subjective symptom), "often" discovered (an objective symptom) and/or "deliberately" pursued by the clinician (a physical sign). To me, it is far more interesting that Crookshank in his "critique of language" faulted Claudius Galen's (neo-Platonist) nosology for grasping a disease

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[145] Barthes, "Sémiologie et médicine."

[146] Foucault, *The Birth of the Clinic*, 91.

"illegitimately" as if it is a real entity by nomination.[147] Barthes, on the one hand, inherited (semio-)linguistics and, on the other, confined himself to the classical problematic despite its lack of full compatibility—how to read the imaginary.

2. 2. 6. Julia Kristeva's "semiotic (chora)" to be "symbolized"?

We could expect reciprocal speech, vulnerable to noises, to mediate in contemporary hospitals. With respect to verbal reports from those in need—insofar as they are not lying—on which the subjective assessments of pain rely, R. Melzack and W. S. Torgerson brought English adjectives describing pain together and categorized them into fairly reliable subclasses.[148] Nonetheless, it remains unsettled to me whether those pain words are more referential than Friedrich Wilhelm Nietzsche's cynical metaphor—"I have given a name to my pain and call it 'dog.' It is just as faithful, just as obtrusive and shameless, just as entertaining, just as clever as any other dog—and I can scold it and vent my bad mood on it, as others do with their dogs, servants, and wives."[149]

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[147] F. Crookshank, "The Importance of a Theory of Signs and a Critique of Language in the Study of Medicine," in *The Meaning of Meaning: A Study of the Influence of Language upon Thought and of the Science of Symbolism*, by C. K. Ogden & I. A. Richards (London: Routledge & Kegan Paul, 1989).

[148] R. Melzack and W. Torgerson, "On the Language of Pain," *Anaesthesiology* 34 (1971): 50-59.

[149] F. W. Nietzsche, *The Gay Science; With a Prelude in Rhymes and an Appendix of Songs* (New York: Vintage Books, 1974), 312-13.

Elaine Scarry urged that physical pain does not only resist linguistic expression but also in reverse destroys it.[150] There she remarked on cries,[151] groans and other sound fragments prior to an infant's language acquisition. These are part of the newly defined "semiotic" (from "le sémiotique" in French), one of two modalities that Kristeva posited of "signifiance."

> [O]ne of them being assumed as a Model Form, intelligible and ever uniformly existent, and the second as the model's Copy, subject to becoming and visible. A third kind […] should be the receptacle, and as it were the nurse, of all Becoming […] for while it is always receiving all things, nowhere and in no wise does it assume any shape similar to any of the things that enter into it […] a third Kind is ever-existing Place (*χωρα*), which […] provides room for all things that have birth, itself being apprehensible by a kind of bastard reasoning by the aid of non-sensation […] for when we regard this we dimly dream and affirm that it is somehow necessary that all that exists should exist *in* some spot and occupying some *place*.[152]

The semiotic includes "drives and their articulations" inside the body.[153] Kristeva stressed its distinctiveness from the Greek etymology. Such discrete quantities of instinctual disposition move endlessly with ephemeral stases which are the moments when the semiotic discharge of energy articulates the amorphous chora (transliteration of "*χωρα*"), a continuum being too unstable yet to be named. Once the semiotic chora is formed (Louis Hjelmslev's usage?) in a still uncertain and indeterminate manner, it must be regulated by the "symbolic" (from "le symbolique" in French), the other modality that generates "signifiance," to produce difference and thereby signification: first, the semiotic pre-language is what antecedes the symbolic phase, that is, the establishment of signs from a developmental point of view; second, the semiotic rhythm is reactivated as (para-)phonetic intonations within the heterogeneous "subject-in-process" and/or "subject-on-trial" (both from "sujet en procès" in French) to be contingent on the symbolic judgment; third and most important to me, the symbolic order shall be transgressed by that very semiotic influx.[154]

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[150] E. Scarry, *The Body in Pain: The Making and Unmaking of the World* (New York: Oxford University Press, 1985).

[151] Christian Heath, "Pain Talk: The Expression of Suffering in the Medical Consultation," *Social Psychology Quarterly* 52 (1989): 113-25.

[152] Plato, *Timaeus*, http://www.perseus.tufts.edu, 48e-52b.

[153] J. Kristeva, *Revolution in Poetic Language* (New York: Columbia University Press, 1984), 43.

Not to mention the coincidence with Scarry's argument, Kristeva's semiotic, it seems to me, pertains to pain language or to its constitution to say the least: for example, both the semiotic and pain may have an intermittent feature in common. I cannot tell if the chora would be the subject's body itself, but it is surely based upon the psycho*somatic* dimension—no less than Hjelmslev's purport that must be articulated.

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[154] A suggestion here from "semanalysis" is that some*thing* (?) sonorous would never entail "the ideologies of communication and normativeness"; it makes sense and/or meaning rather fuzzy: Kristeva, *Revolution*, 17.

2. 2. 7. Paris school's *sémiotique* of passions

Many a chronic patient is documented to be able to eliminate some aversive emotions by detaching him-/her*self* from pain during daily talk: "*I* have it."[155] This subject, constructed through "enunciation,"[156] is neither Cartesian "mind over body" nor, I guess, Maurice Merleau-Ponty's "one's own body" communicating the existential gestures.[157] Verbally, he/she forms (now from Louis Hjelmslev's glossary) his/her body-image, alternative mode of being, encompassing spatially all parts from head to toe—by the unity between senses, especially vision and touch—and temporally—attaching thereto dynamic motility and "memory" as opposed to "recollection."[158]

Likewise a physician seeks out any corporeal site vis-à-vis the medical sign. It may not be extraordinary since, tautologically speaking, what takes place needs a concrete *place*. Indeed we have been asking "where it hurts"[159] but, among the cutaneous senses, pain is from the outset a poorly located one. Furthermore the signal to be decoded as pain and its modulations, could originate from every spot along the spinothalamic pathway. Ultimately pain is perceived at the cortical level where, there is no such thing as *pain centre* though, a distorted map of the body is depicted—namely, homunculus.[160] It looks so weird, compared with a plausible portrait coordinated in the grid system composed of three infinite axes (plus one of time), that a heart attack might accompany pain in the armpit merely because these two parts are adjacent on it.[161]

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[155] E. Scarry, *The Body in Pain: The Making and Unmaking of the World* (New York: Oxford University Press, 1985), 5-6; Jean Jackson, "Chronic Pain and the Tension between the Body as Subject and Object," in *Embodiment and Experience: The Existential Ground of Culture and Self*, ed. Thomas J. Csordas (Cambridge: University of Cambridge Press, 1994).

[156] Émile Benveniste, *Problems in General Linguistics* (Coral Gables: University of Miami Press, 1971), 223-30.

[157] M. Merleau-Ponty, *Phenomenology of Perception* (London: Routledge & Kegan Paul, 1962), 177-86.

[158] Henry Bergson, *Matter and Memory* (London: George Allen & Unwin, 1911).

[159] Michel Foucault, *The Birth of the Clinic: An Archaeology of Medical Perception* (New York: Pantheon Books, 1973); Roland Barthes, "Sémiologie et médicine," in *Œuvres complètes, t. IV* (Paris: Éditions du Seuil, 2002).

> [I was] suddenly aware of a sharp cramp in my left leg. I tried to get at it… with my single arm, but, finding myself too weak, hailed an attendant. "Just rub my left calf,… if you please." "Calf?… You ain't got none, pardner. It's took off."
>
> –Anonymous, 1866[162]

It is a much more astounding clinical fact that people who have lost any limb feel so vividly as though *it* were still there: such "phantom" sensations—including pain of course—incorporate the body-image as a whole that is not broken even after amputation.

I will pay attention to an ongoing semiotic project set out by Algirdas Julien Greimas (his last!) and colleagues since the late 1970s. Greimas and Jacques Fontanille were right to revisit Hjelmslev's theme overtly, which, hinted by as early as Plato, has recurred in Ferdinand de Saussure's postulate of linguistic value and thenceforth—i.e. how to analyze a continuum. Once the focus was on the world that surrounds us,[163] now it ought to be on our "sensate body" as our way of *being-in-the-world.*[164] It is in this realm of "tensivity" that we elaborate Hjelmslev's tradition and simultaneously get ready to discuss *visual* perception—behind (?) verbalization—and clinicians' hypothetico-deductive[165] or "abductive" inferences which Hjelmslev, unlike Charles Sanders Peirce,[166] used to put in parenthesis.

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[160] Wilder Penfield and Theodore Rasmussen, *The Cerebral Cortex of Man: A Clinical Study of Localization of Function* (New York: The Macmillan Company, 1955).

[161] Jack George Thompson, *The Psychobiology of Emotions* (New York: Plenum Press, 1988), 35.

[162] Cited in R. Melzack, "Phantom Limbs," *Scientific American* 266, no. 4 (1992): 90.

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[163] Umberto Eco, *Semiotics and the Philosophy of Language* (New York: The Macmillan Press, 1984), 45.

[164] A. Greimas and J. Fontanille, *The Semiotics of Passions: From States of Affairs to States of Feeling* (Minneapolis: University of Minnesota Press, 1993), xxii.

[165] Arthur S. Elstein et al., *Medical Problem Solving: An Analysis of Clinical Reasoning* (Cambridge: Harvard University Press, 1978).

[166] *Collected Papers* (Cambridge: Harvard University Press, 1931-35 & 1958), Volume V, paragraphs 182-94.

3. Synthetic framework

> Perhaps I might begin by noticing how different numbers have found their champions. Two was extolled by Peter Ramus, Four by Pythagoras, Five by Sir Thomas Browne, and so on. For my part, I am a determined foe of no innocent number; I respect and esteem them all their several ways; but I am forced to confess to a leaning to the number three in philosophy. In fact, I make much use of three-fold divisions in my speculations. –Charles Sanders Peirce[167]

Adopting the perspectives of semiotics and French stoicism, e.g. Gilles Deleuze, let me introduce a triadic model so as to help readers: illness, signs, diagnosis (Figure 3. 1. 4-1). From this understanding of communication arises my central question: "Using historically grounded case studies, what are the semiotic consistencies in visualizing human bodies for medical purposes?" I pose thenceforth four probes from the state-of-the-art to the Roman legacy regressively, expecting that unclear things will be lit by their archaisms: knowledge advances while moving back in time.[168]

3. 1. Triad in medical imaging

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[167] *Collected Papers* (Cambridge: Harvard University Press, 1931-35 & 1958), Volume I, paragraph, 355 (citation is to *CP* Volume. paragraph).

[168] Régis Debray, *Vie et mort de l'image: Une Histoire du regard en Occident* (Paris: Éditions Gallimard, 1992), 17.

3. 1. 1. First step: illness—an *error* within bodies

This stage happens to carry on, with dis-ease. By that hyphen, I intend to cast doubt upon the importance of such nominal conceptions as colds and influenza over the Deleuzian events of nasal congestion/sneezes, sore throat/racking coughs, and muscle weakness/aches. A deviation befalls organisms that have been healthy: i.e. natural, humourally balanced, statistically average. Owsei Temkin would call me a "physiologist" who prefers the denominator of *sickness* indicating an experience of symptoms to some "ontological" matter of *disease* as really existing.[169]

Two problems are herewith: if the whole process of tuberculosis must have begun with a trivial indisposition before the *consumption* outbreak according to Gaspard Laurent Bayle,[170] this physiological attitude sounds like a diachronic ontology. Secondly, asked Georges Canguilhem in 1943, are such ailments *continuously* extended from well-being? Thus he suggested two decades later the notion of "error" or mistake, whose rather fundamental chances are carried within.[171] It sounds unique enough to be eventuality. To confuse this construct of *dysfunction* with any noxious enemies that have intruded—e.g. bacteria, germs as Thomas Sydenham (1624-89) did—or something that we can surgically remove is an etiological fallacy.[172]

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[169] O. Temkin, *The Double Face of Janus and Other Essays in the History of Medicine* (Baltimore: The Johns Hopkins University Press, 1977), 419-55; see also Robert P. Hudson, "Concepts of Disease in the West," in *The Cambridge World History of Human Disease*, ed. Kenneth F. Kiple (Cambridge: Cambridge University Press, 2003).

[170] *Recherches sur la phthisie pulmonaire* (Paris: Gabon, 1810).

[171] G. Canguilhem, *The Normal and the Pathological* (New York: Zone Books, 1991); Temkin seems not to have cited him.

3. 1. 2. Second: becoming-sign

> According to Balzac's theory, all physical bodies are made up entirely of layers of ghostlike images, an infinite number of leaflike skins laid one on top of the other. Since Balzac believed man was incapable of making something material from an apparition, from something impalpable—that is, creating something from nothing—he concluded that every time someone had his photograph taken, one of the spectral layers was removed from the body and transferred to the photograph. Repeated exposures entailed the unavoidable loss of subsequent ghostly layers, that is, the very essence of life. –Felix Nadar[173]

Based upon Democritus' atomic philosophy, *simulacra* (e.g. shapes; flavours, textures) at the shallow level along with *phantasms* (odours, sounds) travel from such ever-changing constellations to us as Epicurus and Titus Lucretius Carus were firmly convinced: so we could see, taste, feel and/or smell, hear *indications* of malady (e.g. paleness, acrid sweat, lump; foul breath, chest murmur; see **2. 1. 1. 1**).

Such accessible information via the diverse avenues should be integrated: for instance, as *the eyes want to caress and the hands to look*, the x-rayed contour of a heart corresponds to its size measured by percussion.[174] I shall nonetheless explore principally visualization (e.g. photography through nuclear magnetic resonance imaging).

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[172] T. Sydenham, *Medical Observations Concerning the History and Cure of Acute Diseases* (London: The Sydenham Society, 1848), 11-24.

[173] "My Life as a Photographer," *October* 5 (1978): 9.

3. 1. 3. Third: dia- or prognosis

For this medicine-specific step, a hypothetico-deductive *interpretation* of the obvious yet conjectural evidence turns ambiguity into certainty by validly corroborating and rectifying the gathered data,[175] whereas induction *to a limited extent* has become viable since the modern hospital started admitting many similar patients for enabling observation. Imaging devices have strengthened the qualitative diagnosis of anomaly with two exceptions: positron emission tomography expresses *numerical* standards in colours, and ultra-violet photography made *prognosis* almost feasible (see **7. 3** & **5. 1** respectively).

The elaboration of this cognitive process has lagged behind that of not only biomedical laboratory but any other clinical activities where the formidable tasks comprise problem solving and decision making over a small amount of sources for a cure. We update any given nosology (e.g. dictionary, manual) where diagnoses are duly assigned, by fitting morbid entities into the pre-labelled niches. Against my sequential framework into which changing historical visualizations are inserted; Lester S. King repeated Galenism when saying that ③ a series of categories leads ①-② any particular object to be put therein.[176] Newly arranged illness and its signs, constant until technological apparatuses enlarged sem*e*iology, have the old nomenclature periodically discarded.

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[174] Francis H. Williams, "A Method for More Fully Determining the Outline of the Heart by Means of the Fluoroscope Together with Other Uses of This Instrument in Medicine," *Boston Medical & Surgical Journal* 135 (1896): 335-37.

[175] Samuel Putnam and William B. Stiles, "Verbal Exchanges in Medical Interviews: Implications and Innovations," *Social Science & Medicine* 36 (1993): 1597-1604.

3. 1. 4. Between secondness and thirdness: virtualization

> With a sudden shudder of happiness I had heard the noise that was common to the spoon touching the plate and the hammer striking the wheel, or had felt, beneath my feet, the unevenness that was common to the paving-stones of the Guermantes courtyard and to those of the baptistery of St. Mark's, [...] let a noise or a scent, once heard or once smelt, be heard or smelt again in the present and at the same time in the past, *real without being actual, ideal without being abstract.*
>
> –Marcel Proust[177]

Prior to diagnosis, medical technology detaches signs off *hic et nunc*—i.e. the sick—and sends them some place where the doctor stays. Therefore no actual encounter with every concerned party would now be necessary[178] but *immutable mobiles*, whether printed or still on-screen, circulate.[179] However, centrifugal factors that keep a physician from her/his patient (e.g. epidemiological pictures, radiographs taken 300 cm off the tube) should be less desirable than centripetal ones in connecting the geographically distant two (Willem Einthoven's phonocardiograms, genuine e-health care; see **Chapter 8**). Likewise, delivering private images online can imply negative alienation.

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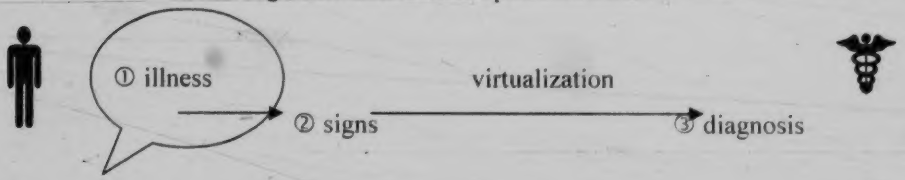
[176] L. King, *Medical Thinking: A Historical Preface* (Princeton: Princeton University Press, 1982), 90-104.

[177] *Remembrance of Things Past, v. 3* (New York: Random House, 1981), 905-6; only italics quoted in Gilles Deleuze, *Proust and Signs* (New York: George Braziller, 1972), 57.

[178] Medical Imaging Technology Roadmap Steering Committee, *Report of Working Group 3: Transmission and Connectivity* (Ottawa: Industry Canada, 2001).

Figure 3. 1. 4-1. Three-plus-one schema



Henri Bergson, when saying "the more the distance decreases between this object and our body [...] the more does virtual action tend to pass into real action [...] Our sensations are, then, to our perceptions that which the real action of our body is to its possible or virtual action,"[180] confused not merely reality (a part of which virtuality as such fully possesses in effect) with actuality[181] but also possibility with virtuality.[182] Only the actual is virtualized and vice versa creatively (Table 3. 1. 4-1). We should address this problem, Gilles Deleuze quotes Bergson, diachronically e.g. qualitative differences and intuition—a Bergsonian method.[183] Admittedly, my examples are more about spatial extension: Pierre Lévy cites Michel Serres' notion of "not-there."[184]

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[179] Bruno Latour, *Pandora's Hope: Essays on the Reality of Science Studies* (Cambridge: Harvard University Press, 1999), 306-7.

[180] H. Bergson, "Matiere et memoire," in *Oeuvres* (Paris: Presses Universitaires des France, 1970); translated as *Matter and Memory* (London: George Allen & Unwin, 1911), 58.

[181] Compare "real, and so to speak instantaneous" with "actual and so to speak instantaneous" in *Matter and Memory*, 70 & 279. Nancy Margaret Paul and W. Scott Palmer, the English translators, corrected "ces souvenirs deplacent nos perceptions *reelles*" in *Oeuvres*, 183

Table 3. 1. 4-1 Bergsonist metaphysics[185]

reality		(possibility)
actuality	virtuality	
synchronicity	duration	
non-organism	*élan vital*	
completion	progression	

---

into "these memories supplant our *actual* perceptions" in *Matter and Memory*, 24; italicized by me.

[182] The former as non-existent is neither less than nor, for this reason, precedes but resembles the latter. Hence no realization subject to limitation or *possibilization*—this Leibnizian idea of "possible" and the virtual-real dichotomy are false. Bergson, "La Pensee et le mouvant" in *Oeuvres*.

[183] Deleuze, *Bergsonism* (New York: Zone Books, 1988).

[184] P. Lévy, *Becoming Virtual: Reality in the Digital Age* (New York: Plenum Trade, 1998), 28-29.

[185] R. Shields, *The Virtual* (London: Routledge, 2003), 28; revised by me.

3. 2. Retroactive discussions

3. 2. 1. Are old technologies forced to obsolescence by new ones?

> In 1816, I was consulted by a young woman labouring under general symptoms of diseased heart, and in whose case percussion and the application of the hand were of little avail on account of the great degree of fatness. The other method just mentioned [direct auscultation] being rendered inadmissible by the age and sex of the patient, I happened to recollect a simple and well-known fact in acoustics, and fancied, at the same time, that it might be turned to some use on the present occasion. The fact I allude to is the augmented impression of sound when conveyed through certain solid bodies,—as when we hear the scratch of a pin at one end of a piece of wood, on applying our ear to the other. Immediately, on this suggestion, I rolled a quire of paper into a sort of cylinder and applied one end of it to the region of the heart and the other to my ear, and was not a little surprised and pleased, to find that I could thereby perceive the action of the heart in a manner much more clear and distinct than I had ever been able to do by the immediate application of the ear.
>
> –René Théophile-Hyacinthe Laënnec, *De l'Auscultation médiate*[186]

Salvatore Mangione and Steven J. Peitzman regret that bacteriologists and physiologists in the twentieth century discarded the person-to-person kind of examination started by French organ pathologists.[187] Among them, as Stanley Joel Reiser maintains, Laënnec's stethoscopic revolution (see **8. 1. 1**) had already entailed striking effects—most notably, precision.[188] Nevertheless, these should favour physicians: their sophistication has been hardly worn away but rather technologically enhanced and slightly far-reaching, just like a fairly transparent instrument (e.g. dental probe) through which one experiences the world is absorbed into an extension of self.[189] The authenticity of hands-on diagnosis held traditionally by those MD commentators—Mangione, Peitzman and Reiser notwithstanding two separate chronologies—seems however mythical to me, it vanished long ago.

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[186] *A Treatise on the Diseases of the Chest* (New York: Haftner Publishing Company, 1979), 284-85.

It may be worth previewing in my reservation about *science* studies that medicine has been Hippocratic *τεχνη* or a set of skills. This also supports Martin Heidegger's claim for the primacy of *praxis*, above which there exist no theories: i.e. abstract knowledge is a child of technology.[190] Neil Postman quotes a clinician who prescribed computer tomographs merely because otherwise his clients could have sued; *life is short, the art long*. Other than listening to such patients' complaint patiently, he needs training in visual interpretation. "Technology changes the practice of medicine by redefining what doctors are," Postman criticizes.[191] They as technicians, I would reply, have practised medicine accordingly from scan-based analysis to mediated hearing that co-exists with it at present.

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[187] S. Mangione and S. Peitzman, "Physical Diagnosis in the 1990s: Art or Artifact," *Journal of General Internal Medicine* 11 (1996): 490-93.

[188] S. J. Reiser, "Technology and the Eclipse of Individualism in Medicine," *Pharos* 45 (1982): 10-15.

[189] Don Ihde, *Technics and Praxis* (Dordrecht: D. Reidel Publishing Company, 1979), 3-39.

[190] M. Heidegger, *The Question Concerning Technology and Other Essays* (New York: Harper and Row, 1977), 12-23.

3. 2. 2. Did the sign replace its symptoms?

Originally, symptomatology would be compatible with semeiotics as both signs and symptoms denoted a somatic failure; Michel Foucault emphasizes the demarcation of a doctor's objective tests from his patient's subjective phenomena or narrative thereof.[192] Using gadgetry, it became admittedly possible to assess hard data like the sheer risk of *hyper*-tension (a physiological state judged individually and hence arbitrarily; see **3. 1. 1**) with little discomfort to the participant.[193] However, before the regime of such tools, Leopold Auenbrugger whose treatise Jean-Nicolas Corvisart would later annotate in French [1808] executed naked-ear auscultation/palpation at the bedside[194] which devalued his affected clients' grumbling as being inaccurate since they had no ability to articulate it or were dishonest. Even a new language of *Séméiologie générale* by François-Joseph Double came out prior to Laënnec's episode. I find substitution instead when physicians relied on their bare senses.

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[191] N. Postman, *Technopoly: The Surrender of Culture to Technology* (New York: Alfred A. Knopf, 1992), 97-105.

[192] M. Foucault, *The Birth of the Clinic: An Archaeology of Medical Perception* (New York: Pantheon Books, 1973), 88-95.

[193] Sir George White Pickering, *Hypertension: Causes, Consequences and Management* (Edinburgh: Churchill Livingstone, 1974), 32-36; Martin Duke, *The Development of Medical Techniques and Treatments: From Leeches to Heart Surgery* (Madison: International Universities Press, 1991), 49-54.

[194] L. Auenbrugger, *Inventum novum* (London: Dawsons of Pall Mall, 1966).

This *sign vs. symptom* dichotomy often appears mutually inclusive since fever is grasped externally, like jaundice; it also hurts *per se* like itching.[195] Also in the example above, how could we call a sufferer's *discomfort* and *grumble* equally symptomatic? Is the latter not closer to his/her doctor's sympathetic account of the former? Just like a detectable *risk* (expression-substance in Louis Hjelmslev's term; see Figure 2. 2. 5-1) sign-ifies hypertension (content-purport) so do vocal grumblings (expression-purport) indicate solipsistic discomfort (content-substance).

Figure 3. 2. 2-1. Double signification of symptoms

expression-purport	symptom, describing			linguistic c.	verbalization
expression-form	↓				
expression-substance	sign		sensory communication		
	↑				
content-substance	symptom, introspected	within the body			
content-form	↑↓				
content-purport	illness				

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[195] Robert S. Blacklow, "The Study of Symptoms," in *MacBryde's Signs and Symptoms: Applied Pathologic Physiology and Clinical Interpretation* (Philadelphia: Lippincott, 1983), 1.

3. 2. 3. How have people compared five kinds of sensation?

> In our Christian religion I believe as we all should believe, many things that we do not see … but it is by means of the faith which obliges us to; … but in medicine I believe only that which I see. –G. Patin, 1631[196]

Subterranean *phantasms* must bulge, together with *simulacra* on the outermost non-transparent layer of a body (Figure 3. 2. 3-1), to point at whatever is wrong inwardly so as for us to infer any malady. On top of that, lofty vision has indeed *represented* the four lowly faculties: Alanus de Insulis' poem around 1200 featured the allegorical horses for—

> Eye (*visus*) which "surpasses his mates in training, grooming and speed";
> Ear (*auditus*) travelling like the wind;
> Nose (*olfactus*) breathing in fragrant air;
> Mouth (*gustus*) eating and drinking to serve the above three;
> And hand (*tactus*).[197]

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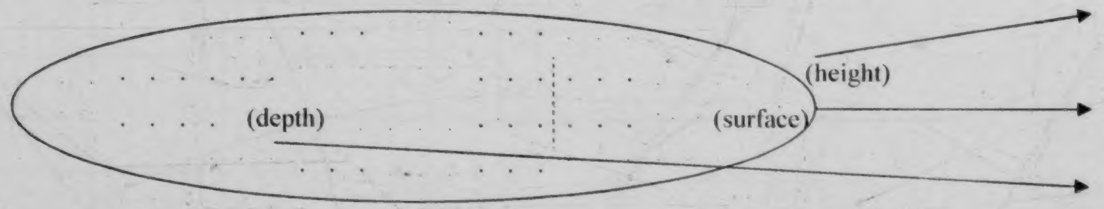
[196] Francis R. Packard, trans. *Guy Patin and the Medical Profession in Paris in the XVIIth Century* (New York: A. M. Kelley, 1970), 79-80.

[197] Alan of Lille, *Anticlaudianus or the Good and Perfect Man* (Toronto: Pontifical Institute of Mediaeval Studies, 1973), IV, 95-96; F. Mütherich, "An Illustration of the Five Senses in Mediaeval Art," *Journal of the Warburg and Courtauld Institutes* 18 (1955): 140-41 (see **8. 2. 2**).

Yet we never *view* a person's chest through stetho-*scopy*[198] that is half-auditory/half-tactile. Did the positive gaze become olfactory/culinary—more than, à la Michel Foucault, *discursive*? *Regard* in his *Naissance de la clinique*'s subtitle is translated into *Perception* and it was in contrast *le tact*, said Jean Nicholas Corvisart, which could enable an established diagnostician to synthetically glance (*coup d'œil*) at *scenes.*[199] His pupil, René Théophile-Hyacinthe Laënnec, found this skin-to-skin approach too intimate for a female. So much for metonymy; Claudius Galen (129-216 A.D.) also sought signals to the patient's vitality by fingering her/his pulse—its strength, frequency, rhythm etc.

Figure 3. 2. 3-1. Reproduction of figures in **2. 1. 1. 1**



(*φαντασμα*)	(*ειχον* or *ειδωλα*)	
		sight
scent what is diffused abroad	munch and lick	
hear through sinuous courses	touch	

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[198] Jacalyn Duffin, *To See with a Better Eye: A Life of R.T.H. Laennec* (Princeton: Princeton University Press, 1998).

[199] J. N. Corvisart des Marets, *An Essay on the Organic Diseases and Lesions of the Heart and Great Vessels* (Birmingham: The Classics of Medicine Library, 1984), 19-20.

3. 2. 4. In all these respects, what can be learned from classical medicine?

It is more right to err with Galen than be right with others. –Bartolomeo Eustachi?

When signs of malady end up at a doctor, the *logos* comes in. Did this pre-exist sensory modalities? Claudius Galen, who is said to be responsible for sterile rationalism, derived reasoning from his initial attention to patients; universal theory was seldom *a priori* but surprisingly induced from the accumulated experiments. How frequently? He replied: *very many times*.[200] Hence the opposite school of empiricism[201] is combined into our practical scientist who embraced an impromptu judgement to be confirmed, refuted, or corrected during routine face-to-face exercises: if a disease does not manifest trivial *σημεια*, Galen waits before employing any intellect.[202] We should neither identify this rarely disturbed millennial authority with his radically dogmatic heirs in the 16th century[203] nor another paradoxical character, Thomas Sydenham, who relied upon five perceptible criteria but aimed for nosographic profundity[204] beyond *syndrome* (i.e. a shallow constitution of all symptoms, like Attention Deficit Hyperactivity Disorder, not elucidating why) to pigeonhole individual cases into typical genera and species.

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[200] Galen, *On Medical Experience* (London: Oxford University, 1944), 96 ff.

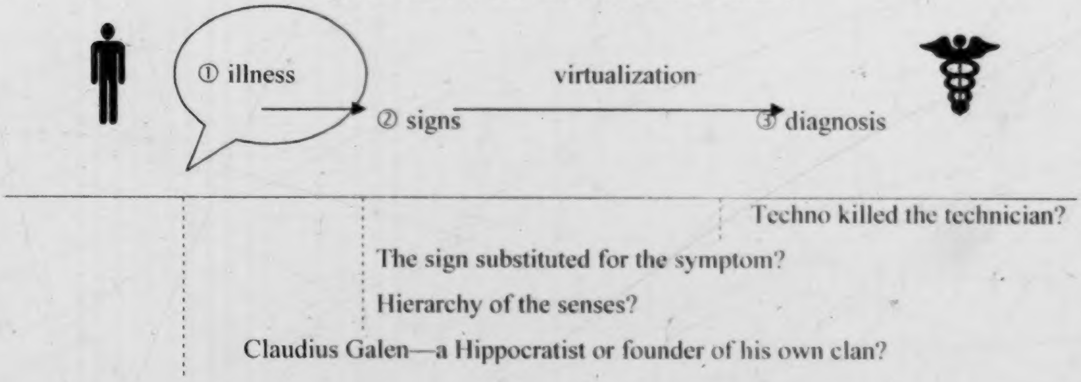
[201] Ludwig Edelstein, *Ancient Medicine* (Baltimore: The Johns Hopkins Press, 1967), 195-203.

[202] Luis García Ballester, "Galen as a Medical Practitioner: Problems in Diagnosis," in *Galen: Problems and Prospects*, ed. Vivian Nutton (London: Wellcome Institute for the History of Medicine, 1981), 17.

[203] For instance, Jean Fernel, *On the Hidden Causes of Things: Forms, Souls and Occult Diseases in Renaissance Medicine* (Leiden: Brill, 2005).

[204] Phillip De Lacy, "Galen's Platonism," *American Journal of Philology* 93 (1972): 27-39.

Figure 3. 2. 4-1. Schema and four heuristics


① illness
virtualization
② signs
③ diagnosis
Techno killed the technician?
The sign substituted for the symptom?
Hierarchy of the senses?
Claudius Galen—a Hippocratist or founder of his own clan?

In conclusion to this chapter: while compromising both tenets, I am no extreme Galenic epistemologist but a believer in the spontaneous procedures of illness,[205] semeiotic crafts (man-to-man or equipped) in the *visual*—no metaphor for or dominance over auditory, olfactory, culinary, tactile assumed—inspection of those signs/symptoms, and some *abductive* guess by Charles Sanders Peirce of Aristotelian syllogism that follows as my third phase in the whole model.

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[205] Thus charlatans' (*εμπειρικος*) knowledge expansion through similar histories and prognosis; Harris L. Coulter, *Divided Legacy: A History of the Schism in Medical Thought, v. I. The Patterns Emerge: Hippocrates to Paracelsus* (Washington: Wehawken Book, 1975).

4. Methodology

The following chapter aims to justify not only what subjects I will study but also how—i.e. comparatively and, in Charles Sanders Peirce's spirit, *abductively* (see **2. 2. 3**). My own trichotomous conception of *diagram/metaphor/index*, a variation on *icon/index/symbol*,[206] is subsequently introduced with some would-be diagnostic cases.

4. 1. Hypothetically qualitative

> We know in part and we prophesy in part. –St. Paul[207]

This suggestive (more than empirical) project requires no samples in order to infer about any larger population. I have instead collected data from well-known public domain images, widely used medical texts and archival sources, because they are characteristically rather than statistically representative for each phenomenon of interest: e.g. (1) autopsy drawing, (2) clinical photography, (3) x-rays, (4) computer-assisted tomography, (5) nuclear magnetic resonance imaging, (6) positron emission tomography, (7) phonocardiography, (8) ultrasonics.

To narrow down the scope of research further, let me leave aside from semeiotics (1) post-mortem (see **4. 2. 2**) since regretfully no signs are there to ex-hibit

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[206] C. S. Peirce, *Collected Papers* (Cambridge: Harvard University Press, 1931-35 & 1958), Volume II, paragraph 247.

[207] *Bible*, 1 Corinthians 13:9.

(etymologically *out of/from + to have/hold*) anything that sub-sists (*below/under/secretly/near + to remain/come to a stand*; cf. ex-ists) beneath the skin. As much frustrated by dissection as William Harvey in *Exercitatio anatomica de motu cordis et sanguinis in animalibus* dated 1628 for how quick things move (see **8. 2. 1. 1**) was John Locke with Thomas Sydenham, the Hippocrates of England, 40 years later: "If therefore anatomie shew us neither the causes nor cures of most diseases I think it is not very likely to bring any great advantages for removeing the pains and maladys of mankind."[208]

To similarly reduce the number of case histories, (2) colour-painted as well as ultra-violet pictures are marginalized; I will discuss their overlap respectively with (1) penciling upon the *camera obscura* lens and (3) roentgenography.[209] Contrary to immediate visual measures, (7) PCG and (8) sonography, like electricity-sourced apparatuses (e.g. ECG, EEG), convert their acoustic origin into another type of energy. Let me feature phonocardiography, which seldom improved over decades,[210] merely as an old example of virtual diagnosis (Figure 4. 1-1).

Aesthetic, yet scientifically discredited, phrenology is deliberately ignored because such bizarre allegories of physiognomy did not last beyond early-1800 psychiatry.[211] 3-dimension mannequins carved from wax, ivory or wood have rendered no aid to diagnostics but its pedagogy[212] for instance when midwives were explaining pregnancy to the public. I exclude these two from a manageable dissertation attempting to contrast x-rays with C(A)T which discloses *in vivo* sections, CT with MRI capturing the soft tissue instead of bones, and MRI with PET composed of Peircian *diagrams*.

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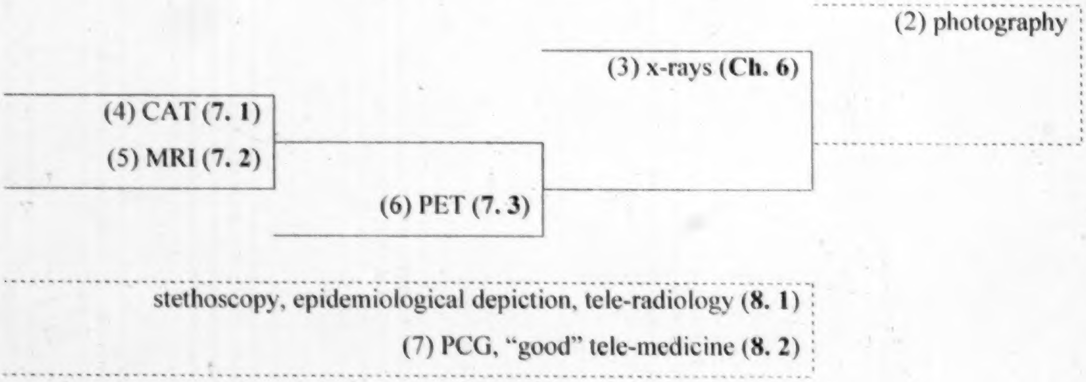
[208] Published in Kenneth Dewhurst, "Locke and Sydenham on the Teaching of Anatomy," *Medical History* 2 (1958): 4.

[209] Its radiation "differs from visible light only in wave length." Arthur W. Fuchs, "Evolution of Roentgen Film," *American Journal of Roentgenology, Radium Therapy and Nuclear Medicine* 75 (1956): 30.

[210] D. H. Bekkering, "Biomedical Engineering: Looking Back Over Twenty Years," *Medical Progress Through Technology* 7 (1980): 70-72.

Figure 4. 1-1. Schema of contents


(2) photography
(3) x-rays (**Ch. 6**)
(4) CAT (**7. 1**)
(5) MRI (**7. 2**)
(6) PET (**7. 3**)
stethoscopy, epidemiological depiction, tele-radiology (**8. 1**)
(7) PCG, "good" tele-medicine (**8. 2**)

My comparisons, an investigative means that I. Auguste M. F. X. Comte regarded "so specially adapted to the study of living bodies" in *Cours de philosophie positive*,[213] are neither always cross-sectional nor longitudinal: thus Hellenistic illustration (see **4. 2.**

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[211] See e.g. Sander L. Gilman, *Disease and Representation: Images of Illness from Madness to AIDS* (Ithaca: Cornell University Press, 1988), 32-39.

[212] Fielding H. Garrison and Edward C. Streeter, "Sculpture and Painting as Modes of Anatomical Illustration," in *History and Bibliography of Anatomical Illustration* by Ludwig Choulant (New York: Hafner Publishing Company, 1962), 370.

1) vis-à-vis PET both for being *diagrammatic* more than *metaphorical* or *indexical* despite such a temporal and spatial gap. John Stuart Mill thought of classification as subsidiary to inductive name-giving.[214] I have deduced, from some hypotheses about general semiosis without which nothing could be ascertained by experiencing it repeatedly, three cognitive patterns above that seek to verify whether they are suitable for each particular imaging mode.

Charles Sanders Peirce blames Mill for getting Johannes Kepler's discovery wrong: locating Mars at some points, our astronomer could only presume its trajectory beyond them. Among numerous curves upon which those spots are plausibly accounted for, he selected an elliptical orbit, where the planet would be later noticed passing.[215] This *abductive* mindset that "proceeds from Rule and Result to Case"[216] is a partial transposition of Aristotelian syllogism[217] from the truistic predicate of a species (rule; e.g. men are mortal) and the definition of an individual into that species (case; Socrates was a man) to the predicate of that individual (result; Socrates must have died). In the common-

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[213] A. Comte, *The Positive Philosophy*, Book V, Chapter I, http://socserv2.mcmaster.ca/~econ/ugcm/3ll3/comte/Philosophy2.pdf

[214] J. S. Mill, *A System of Logic: Ratiocinative and Inductive* (London: Longman, Green, and Co., 1906), Book IV, Chapter II.

[215] C. S. Peirce, *Collected Papers* (Cambridge: Harvard University Press, 1931-35 & 1958), Volume I, paragraphs 71-72 (citation is to *CP* Volume. paragraph).

[216] *CP* II. 712.

[217] Aristotle, *Posterior Analytics*, Book II, http://etext.library.adelaide.edu.au/a/aristotle/a8poa/

sense universe, we choose or even invent rules[218] (not waiting till every man dies away), the result is that of circumstantial observations rather than a case of the rule (Socrates appeared dead) and we extrapolate such a resulted fact toward new cases (others shall be mortal) to adequately test the rule. With however many cases and results, induction can hardly warrant a rule; deduction is non-heuristic; Peircian abduction seems fruitful[219] in the field, which nevertheless would not naïvely let us go theory-free. Miri Levin-Rozalis insists:

> There are no a priori hypotheses, no presuppositions, no theorizing in advance: "Abduction is a process of drawing conclusions that includes preferring one hypothesis over others which can explain the facts, when there is no basis in previous knowledge that could justify this preference or any checking done" (Peirce 1955, p. 151). It is worthy of note that the hypothesis mentioned by Peirce does not arise from any theory, but from the facts.[220]

The correct quotation, before Levin-Rozalis modified it, should have gone, "This [*abduction* or *retroduction*] will include a preference for any one hypothesis over others which would equally explain the facts, so long as this preference is not based upon any previous knowledge bearing upon the truth of the hypotheses, nor on any testing of any of the hypotheses," following a Peircian explication of hypothesis: "not merely a supposition about an observed object […] but also any other supposed truth from which would result such facts as have been observed."[221] Abduction that begins with a deductive rule like the celestial regularity, about which Kepler must have read,[222] does not sound closer to blind induction.[223] I should hence move on from—

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[218] "It is an act of *insight*, although of extremely fallible insight. It is true that the different elements of the hypothesis were in our minds before; but it is the idea of putting together what we had never before dreamed of putting together which flashes the new suggestion before our contemplation." *CP* V. 181.

[219] *CP* VIII. 384-87.

> Rule: *indices* are, Peirce reminded us, materially connected to the referent;[224] and
> Result: rays from that object turn out having adhered on the photographic film; to
> Case: radiological pictures may be *indexical* too.

This syllogism differs from *grounded theory* which proceeds beyond event-describing towards data-coding then concept-formulating. Attentive to Peirce the

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[220] M. Levin-Rozalis, "Searching for the Unknowable: A Process of Detection—Abductive Research Generated by Projective Techniques," *International Journal of Qualitative Methods* 3, no. 2 (2004): 9.

[221] *CP* VI. 525.

[222] *CP* V. 362.

[223] Peirce grouped the 1878 example (all the beans from this bag are white; these beans are white; these beans are from this bag) along with inductive case-result-rule (these beans are from this bag; these beans are white; all the beans from this bag are white) as synthetic alternatives to deduction (all the beans from this bag are white; these beans are from this bag; these beans are white). *CP* II. 623. Then, everything remains unfortunately at where he found beans and the bag.

[224] Like the finger, an *index* not only points but prints: e.g. some trace indicated to Robinson Crusoe that he was not alone on the isle. *CP* IV. 531. Let me take this stronger term.

pragmatist's contribution though, Anselm L. Strauss[225] forgot that abductive methods start with a tentative rule; its result is sampled—if ever—hypothetically not theoretically; we ultimately gather other cases. Let me examine those of x-rays above via Peircian *indexicality*; Levin-Rozalis and Strauss would empirically and inductively liken it to photography as the result and constantly explore similar cases yet without any rule in mind. For my thesis, semiotics has already emerged rather than needs additional generation; it works as merely an organizing chest; no further theory is ambitioned to come out.

4. 2. Semiotic examples

> I am forced to confess to a leaning to the number three in philosophy.
>
> -Charles Sanders Peirce[226]

Why do neither Saussurians[227] nor anybody else but Peirce, into whose categories of *diagram*, *metaphor* and *index* several imaging technologies from autopsy representations to ultrasound will get pigeon-holed, matter here? It concerns to what degree the legacy of symptomatology has been preserved. He owed Hippocratism to John Locke, once Oxford's empirical student of medicine. For these two, semiotic was cognate to logic rather than diagnostic, and Patrick Romanell calls Peircian pragmaticism, unlike pragmatism of William James a physician cum philosopher à la Locke, mathematically driven.[228] Yet the feud between America's contemporary duo pertained to how much habits are deemed real[229] not to what they non-academically did, and Peirce acquainted himself with medical reasoning in classics: when completing the "historical, plain" inquiry by adding sceptical conjecture,[230] Romanell reaches an epistemological triad of *historical* description, *plain* utility and, in compensation for the lack of such clarity, agnostic guess.[231] More directly, Peirce used 3*3 typologies just as mediaeval doctors did:

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[225] *Qualitative Analysis for Social Scientists* (Cambridge: Cambridge University Press, 1987).

[226] *Collected Papers* (Cambridge: Harvard University Press, 1931-35 & 1958), Volume I, paragraph 355 (citation is to *CP* Volume. paragraph).

[227] See exceptionally **7. 1** regarding how non-invasive *tomographies* without any scalpel (*τομευς*) fragment our "sensate body." Algirdas Julien Greimas and Jacques Fontanille, *The*

Semiotics of Passions: From States of Affairs to States of Feeling (Minneapolis: University of Minnesota Press, 1993), xxii.

[228] P. Romanell, *John Locke and Medicine: A New Key to Locke* (Buffalo: Prometheus Books, 1984), 181.

[229] *CP* V. 552; W. James, *The Principles of Psychology*, http://psychclassics.yorku.ca/James/Principles/index.htm, Volume 1, Chapter 4.

[230] J. Locke, *An Essay Concerning Human Understanding*, http://www.ilt.columbia.edu/publications/locke_understanding.html, Introduction and Book IV respectively. A manuscript of the latter goes back to a period which Thomas Sydenham and Locke spent together. Richard I. Aaron and Jocelyn Gibb, eds., *An Early Draft of Locke's Essay: Together with Excerpts from His Journals* (Oxford: Clarendon Press, 1936), xiii.

[231] Romanell, 90. See also Figure 2. 2. 2-1 for getting whatever is tripartite (e.g. thing-idea-word) out of explicit dyads (thing-idea/idea-word).

Table 4. 2-1. Pathological signs in the Middle Ages[232]

Pietro d'Abano et al.—*ratione* ...	Arnald of Villanova—*secundum* ...			
... *ipsius essentiae*		*qualitas permutata* e.g. anomalous skin in jaundice	*operatio laesa*—restrictions on the motility	whatever comes out of the body e.g. blood, sweat
	... *ipsam materiam*	*res naturales* e.g. sex, habits, age	... *non naturales* e.g. air, activity/rest, sleep/waking, food/drinks, what happens to the soul	... *contra naturam* e.g. if pores *in some conditions*, then fever
... *significati*	... *ipsum significatum*	*sana*—sign of health	*neutrum*—of neither	*aegra*—of disease
... *modi significandi*				
by reference to the subject		higher faculty: physician's apprehension lower: patient's movement or stop		
inhering in the object		attributes belonging to a body	effects proceeding therefrom e.g. digestion	accidents with diverse causes e.g. hair colour
	... *differentias temporis*	diagnostic—present	mnemonic—past	prognostic—future
applied to tense		e.g. scar—an indication of healing and a commemorative sign of the wound		

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[232] Costantino Marmo, "Definition and Classification of Signs in XIIIth and XIVth Century Medicine," *RS·SI* 18, no. 3-19, no. 1 (1998-99): 25-37.

Why is the second of three Peircian trichotomies[233] important then? He provided it earlier than two other taxonomies: *likenesses*' reference to their correlates "is a mere community in some quality," that of *indices* "consists in a correspondence in fact," and such relation of *symbols* "is an imputed character."[234] Without remarking upon *qualisign*, *sinsign* and *legisign* as per se or *rheme*, *dicent* and *argument* in respect to the interpretant,[235] Peirce confirmed decades later: "A sign is either an *icon*, an *index*, or a *symbol*."[236] I recognize those six notions (e.g. *sinsign*) only to question whether it is *iconic* or *indexical*.[237] Besides, diagnostics rarely entertains creativity in that third set.

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[233] Table 2. 2. 3-1 abridged below:

	firstness	secondness	thirdness
first trichotomy	qualisign	sinsign	legisign
second	*icon*	*index*	*symbol*
third	rheme, including term	dicisign or dicent sign	argument

[234] *CP* I. 558. Peirce used *likeness* for *icon* elsewhere. *CP* VII. 467.

[235] It was defined as the "proper significate effects" of a sign: *CP* V. 475-76. See also **Chapter 9** for emotional, energetic and ultimate—or immediate, dynamical and final—interpretants (i.e. feeling, muscular or mental exertion and habit-change). Embarrassingly an editor of *Collected Papers of Charles Sanders Peirce* mistook this for one who interprets the sign. Arthur W. Burks, "Icon, Index, and Symbol," *Philosophical and Phenomenological Research* IX (1949): 673-89. "The Sign creates something in the Mind of the Interpreter […] this creature of the sign is called the Interpretant." *CP* VIII. 179.

[236] *CP* II. 304. This lexicon ended up being a breakthrough. Roman Jakobson, *Language in Literature* (Cambridge: Belknap Press, 1987), 413-427.

[237] Peirce recapitulated ten classes dated 1903 in a year (*CP* II. 264 left and VIII. 341 right).

Neither does arbitrariness of *symbol* in the second trichotomy fit (see **7. 3. 2. 4** for *iconic* subdivisions).

Peircian *metaphors* rely upon further mediation yet, being a third-level *iconicity*, not so much as *symbols* do: for instance, wine is to believers the *metaphor*, if not transubstantiation,[238] of Jesus's blood while to neutral observers a *symbol*; or, would atheists take it as a joke anyway? Umberto Eco warned that semiotics may focus upon the capacity of, if not witticisms, lying.[239] Whereas *diagrams* are relevantly about synecdoche like spots and lines abstracted from their referent,[240] *metaphors* according to Peirce smell more of metonymy or substitution.[241]

I. *qualisign*	V. *iconic legisign*	VIII. *rhematic symbol*	X. *argument*
II. *iconic sinsign*	VI. *rhematic indexical legisign*	IX. *dicent symbol*	
III. *rhematic indexical sinsign*	VII. *dicent indexical legisign*		
IV. *dicent sinsign*			

1. (I) *qualisign*
2. (II) *iconic sinsign*
3. (V) *iconic legisign*
4. (III) *rhematic indexical sinsign*
5. (VI) *rhematic indexical legisign*
6. (VIII) *rhematic symbol*
7. (IV) *dicent sinsign*
8. (VII) *dicent indexical legisign*
9. (IX) *dicent symbol*
10. (X) *argument*

[238] Thanks for Carolina Cambre's tip.

[239] U. Eco, *A Theory of Semiotics* (Bloomington: Indiana University Press, 1976), 64.

[240] *CP* III. 468. See also **7. 3** asking whether the quantitative estimation by positron emission tomography of "where" and "how many" isotopes have been accumulated could be *iconic*.

[241] For a direct link between metaphor and bodily sensation of all kinds: see Marcel Danesi, *Giambattista Vico and the Cognitive Science Enterprise* (New York: P. Lang, 1995).

4. 2. 1. Peircian *diagrammatic legisign*: pseudo-anatomy

> Herophilus, the physician, or rather butcher, who cut up innumerable [in Latin, *sexcentos*] persons in order to examine nature, who hated humans in order to have knowledge, explored their internal parts—but he probably did not explore all of them clearly, since death itself changes what has been alive, especially a death which is not a simple one but one which is an error in the midst of the artificial processes of dissection. –Tertullian[242]

Ever since Erasistratus and Herophilus' teachings in the 3rd century B.C. of vivisection in Alexandria, schemata of a cadaver laid in the froggy posture upon a table were repeated to expose its abdomen *in situ* (Figure 4. 2. 1-1). Although one may link this locally with the ancient Egyptians' tradition of embalming,[243] their hieroglyphics for throat and lungs depicted those of the giraffe and ox,[244] which hints that there were some taboos hindering any major advances in human anatomy. This intellectually thriving city,

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[242] J. H. Waszink, ed., *De anima* (Amsterdam: J. M. Meulenhoff, 1947), 10. 4; translated in Heinrich von Staden, ed., *Herophilus: The Art of Medicine in Early Alexandria* (Cambridge: Cambridge University Press, 1989), 190.

[243] Or even of religious statues, e.g. Bes the god "as a corpulent dwarf with bowed or straddled legs and a mask-like animal visage." L. H. Wells, "Iconographic Origins of Some Early Anatomical Diagrams: A Further Suggestion," *Journal of the History of Medicine and Allied Sciences* 17 (1962): 385-87.

[244] Carole Reeves, *Egyptian Medicine* (Princes Risborough: Shire Publications Ltd., 1992), 26.

I consider, was under the Ptolemies' rule tolerant for its eminent scholars who chopped some prisoners' torso legally.[245]

If any then, such graphic expressions[246] are lost now; yet the Arabs must have scrutinized Greek treatises. While being opposed to optical representation of men just as Christians like Saint Augustine in *De civitate Dei* frowned upon the "cruel zeal for science,"[247] Islam conveniently distinguished between physicians and surgeons-barbers who might be allowed to learn about the corpse in a socially beneficial way. Without performing laborious post-mortem, however, they duplicated by hand whatever had survived from the destroyed Alexandrian museums through classical times. We are given standardized charts which exemplify therefore each component system of bones, nerves, muscles, veins, arteries plus the female reproductive viscera during pregnancy having an unborn baby inside.

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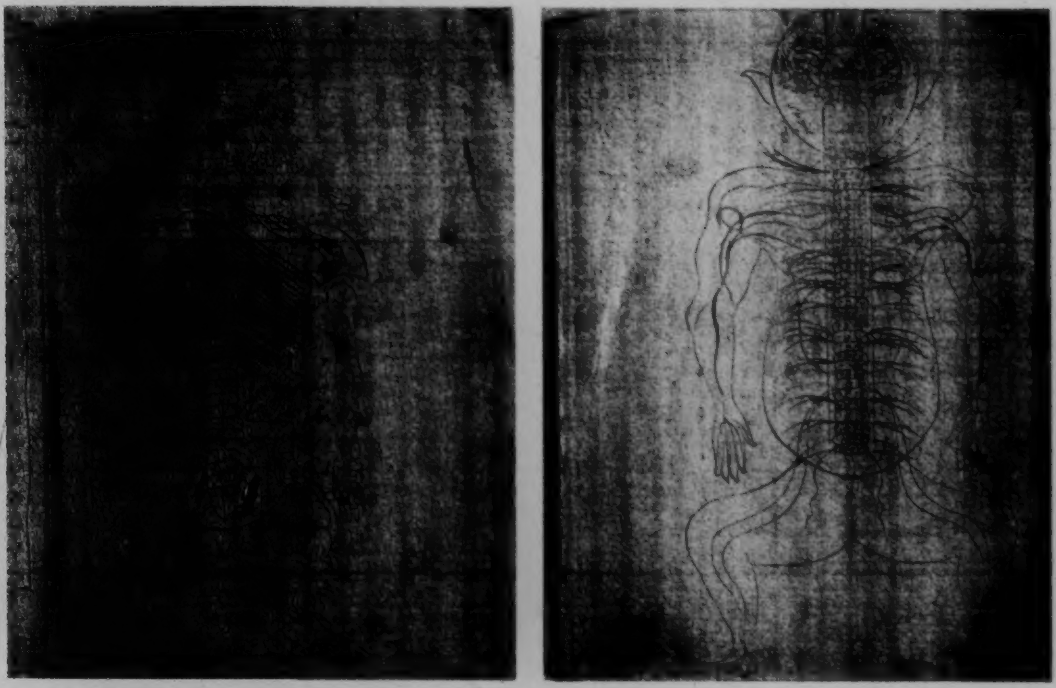
[245] Aulus Cornelius Çelsus, *De medicina* (Birmingham: Classics of Medicine Library, 1989), Prooemium 23-24.

[246] "A *graph* is a superficial diagram composed of the sheet upon which it is written or drawn, of spots or their equivalents, of lines of connection, and (if need be) of enclosures." Charles Sanders Peirce, *Collected Papers* (Cambridge: Harvard University Press, 1931-35 & 1958), Volume IV, paragraph 419 (citation is to *CP* Volume. paragraph).

[247] Thereby, the Bishop of Hippo put, "some medical men, who are called anatomists, have dissected the bodies of the dead, and sometimes even of sick persons who died under their knives, and have inhumanly pried into the secrets of the human body." St. Augustine, *City of God*, http://www.ccel.org/ccel/schaff/npnf102.pdf, Book XXII, Chapter 24.

Figure 4. 2. 1-1. Persian six-picture series[248]



Europeans imported this whimsical cliché around 1000 A.D. and prepared various multi-generation copies manually.[249] Such recourse would cease only with the advent of engraving techniques which made possible massive printing and spread of civilization to those geographically distant from any precious original. Until that era named after Johann

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[248] Mansur ibn Ilyas, *Tashrih-i badan-i insan*, Manuscript P 18, Folios 12b, 18a (see 20a, 25b, 28a, 39b also). http://www.nlm.nih.gov/exhibition/historicalanatomies/mansur_home.html, a U.S. National Library of Medicine site.

[249] See more in Karl Sudhoff, *Ein Beitrag zur Geschichte der Anatomie im Mittelalter: spaziell der anatomischen Graphik nach Handschriften des 9. bis 15. Jahrhunderts* (Hildesheim: Georg Olms Verlagsbuchhandlung, 1964).

Gutenberg, there was this customary *diagrammatization*,[250] less vulnerable to degrading, which Charles Sanders Peirce should have incorporated into his *iconic legisign*.[251]

4. 2. 2. Zoological and botanical *metaphors*: car(di)nal autopsy

> Galen […] undertook to display the positions of the internal organs by the dissection of brutes. Although some animals, such as monkeys, are found to resemble ourselves in external form, there are none so like us internally as the pig, and for this reason we are about to conduct an anatomy upon this animal. – Copho?[252]

Post-mortem was no longer practised at Alexandria when Galenists visited. As well in Rome, grass-root hostilities to it prevailed. Thus our medical authority for more than a millennium must have picked such a detour. Laughing at this, Andreas Vesalius got a simian pet woodcut in the foreground of *De humani corporis fabrica*'s bragging title page since its 1543 version.[253] Likewise at 12th-century Salerno, we suspect, Catholics resumed autopsy by killing the hog without much veterinarian intention.[254]

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[250] Or *skeletonization* whose "purpose is to strip the significant relations of all disguise." *CP* III. 559.

[251] *CP* II. 258.

[252] "Anatomia porci," in *Anatomical Texts of the Earlier Middle Ages: A Study in the Transmission of Culture*, ed. George W. Corner (New York: AMS Press, 1977), 51.

[253] See http://vesalius.northwestern.edu/.

[254] Andrew Cunningham, *The Anatomical Renaissance: The Resurrection of the Anatomical Projects of the Ancients* (Aldershot: Ashgate, 2003), 37-38.

What is worse, after such restrictions imposed on anatomical erudition had relaxed late in the mediaeval period, Galen's successors would falsely expand his contributions to mankind. Frederich II of Germany and Sicily decreed in 1231 that at least every fifth year a human body should be dissected for all physicians and surgeons to eyeball; the 16th century started with *Antropologium* by Magnus Hundt featuring on Page 119 a crude plate of the piggy liver with five lobes,[255] which is barely proximate to ours.

Some praise Leonardo da Vinci for pictorially recording man's corporeality as he might actually have witnessed.[256] Our versatile artist turned enthusiastically to biological phenomena and left behind approximately 800 intricate sketches with precise comments unpublished. Their naturalistic fidelity is such that modern sciences owed this sort of mimetic anatomy for painters or illustration serving doctors. Yet da Vinci's detailed portrayals often contain flawed information based still upon certain old inaccuracies. His inquest into the cotyledonous placenta begins with geometrical experiments (Figure 4. 2. 2-1; bottom, right) and goes from horticultural (centre: bursting like a seed-box) to bovine. Leonardo was loath to abandon such creature-wide homologies as sphericality where birth should be given.[257] I doubt if any of the 30-something people whom he carnally, with some cardinal or powerful families' connivance, sliced apart[258] would have carried an embryo so complicatedly upright. "The heart of this child does not beat," when it sounded like a breech to be delivered buttock-down purportedly, we find da Vinci appending that normal foetuses got anyhow, "vivified and nourished by the life and food of the mother."[259] Diagnostic imaging must have more *ground* in Charles Sanders Peirce's glossary[260] than Leonardo's anatomical drawings.

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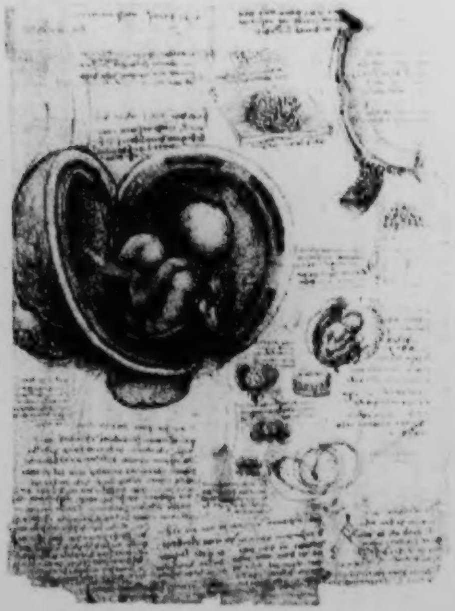
[255] http://www.nlm.nih.gov/exhibition/historicalanatomies/hundt_home.html.

[256] J. Whillis, "Anatomical Illustration," *Journal of Audiovisual Media in Medicine* 24 (2001): 54.

[257] Martin Kemp, *Visualizations: The* Nature *Book of Art and Science* (Oxford: Oxford University Press, 2000), 20-21.

[258] T. V. N. Persaud, *Early History of Human Anatomy: From Antiquity to the Beginning of the Modern Era* (Springfield: Charles C Thomas, 1984), 102.

Figure 4. 2. 2-1. Vincian *metaphorical* post-mortem[261]



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[259] *Leonardo on the Human Body* (New York: Dover Publications, 1983), 474.

[260] "The sign [...] stands for that object, not in all respects, but in reference to a sort of idea, which I have sometimes called the *ground* of the representamen." C. S. Peirce, *Collected Papers* (Cambridge: Harvard University Press, 1931-35 & 1958), Volume II, paragraph 228.

[261] The Royal Collection © 2005, Her Majesty Queen Elizabeth II.

4. 2. 3. *Iconic* and *indexical sinsigns*: camera lucida

While appreciating that any mode in Charles Sanders Peirce's sign trichotomy is possibly blended into another or two rather than rigorously exclusive of them, Roman Jakobson[262] conveniently did not introduce a suggestion by our authority for visual studies which follows: photography (whose border-line application to medicine should be comparable with that of non-invasive anatomy) offers *icons* preceded by *indices*, and even *symbols* having incorporated both. In other words, it takes some law to interpret the appearance excited in one's mind, which comes from a reality that has been stuck upon the chemically abraded silver chloride emulsion. Let me quote Peircianism from elsewhere:

> Photographs, especially instantaneous photographs, are very instructive, because we know that they are in certain respects exactly like the objects they represent. But this resemblance is due to the photographs having been produced under such circumstances that they were physically forced to correspond point by point to nature. In that aspect, then, they belong to the second class of signs, those by physical connection.[263]

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[262] *Language in Literature* (Cambridge: Belknap Press, 1987), 417-18.

[263] C. S. Peirce, *Collected Papers* (Cambridge: Harvard University Press, 1931-35 & 1958), Volume II, paragraph 281 (citation is to *CP* Volume. paragraph).

Philippe Dubois[264] listed a panorama of three attitudes held by Roland Barthes *par excellence*, which hints that he was falling under Peirce's influence. Barthes maintained earlier that mechanical pictures assert their referents tautologically, which fits with journalism,[265] whereas chirographs—i.e. hand drawings[266]—require more human learning. Against this kind of *iconic* mimesis, his reaction like Groupe μ's[267] supported not only socio-culturally but aesthetically coded *symbols*. Then he returned to such *indexical* adherence onto the film that no depth lies therein[268] *à la* mediology: it was in 1964 that Barthes talked about photographic vividness to some previous moment and the phantom (see **6. 2. 2. 1**) or "having-been-there" of a portrayed subject—dead or alive—going left behind.[269]

So rightfully back to Peirce who arguably pioneered those semiotic notions of *icon*, *index* and *symbol*: according to his first classification by their own virtue, a *sinsign* is each happening in and of itself,[270] whose conventionalization on the other hand amounts to a *legisign.* I hereafter claim no such regularity throughout all technographies[271]—where x rays, computerized tomography, nuclear magnetic resonance imaging etc. shall be included—as we have already witnessed in the mediaeval *diagrams* (Figure 4. 2. 1-1) standing like a sumo wrestler or posing like a porn actress.[272]

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[264] *L'Acte photographique et autres essais* (Paris: Éditions Nathan, 1990), 40-49.

[265] R. Barthes, "Sur des Photographies de Daniel Boudinet," in *Œuvres complètes, t. V* (Paris: Éditions du Seuil, 2002; citation is to *ŒC Tome*. *Livre*/"Texte"/"Entretien").

[266] Román Gubern, "From Optical to Digital: When the Same is Different," *Visio* 4 (1999): 55-60.

[267] *Traité du signe visuel: Pour une Rhétorique de l'image* (Paris: Éditions du Seuil, 1992).

[268] *ŒC V*. "Du Goût à l'extase"; in *The Grain of the Voice: Interviews 1962-1980* (New York: Hill and Wang, 1985).

[269] *ŒC II*. "Rhétorique de l'image," 581-84; in *The Responsibility of Forms: Critical Essays on Music, Art, and Representation* (Berkeley: University of California Press, 1991).

[270] *CP* VIII. 334.

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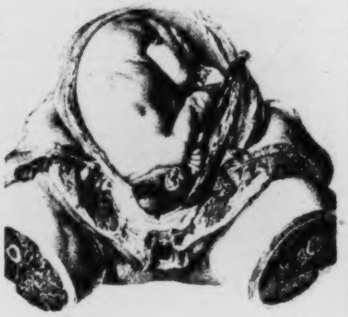
[271] Gubern, "From Optical to Digital."

[272] William Hunter (see **5. 2. 2**) has been condemned unfairly for *analyzing* with a scalpel pregnant women by, for example, Ludmilla Jordanova, *Sexual Visions: Images of Gender in Science and Medicine between the Eighteenth and Twentieth Centuries* (Madison: The University of Wisconson Press, 1989), 60-62; I doubt why Hunter should not have chopped off both thighs, which "require no explanation" as he repeated, and genitalia to gynaecologically test. In terms of gross violence, Jordanova sounds like Tertullian or Augustine—i.e. churchy. As for the accusation of voyeurism, female legs are spread apart in representations that have not been critiqued as obscene: e.g. *portio vaginalis* of late scholasticism in Johannes de Ketham, *Fasciculus medicinae* (Birmingham: The Classics of Medicine Library, 1988), 37.



Hunter, *Anatomia uteri humani gravidi tabulis illustrata*, VI (http://clendening.kumc.edu/dc/rti/reproduction_1774_hunter02.jpg; Courtesy of the Clendening History of Medicine Library, University of Kansas Medical Center)

Table 4. 2. 3-1. Peircian trichotomies of sign

classes	third trichotomy	second trichotomy	first trichotomy
I. (rhematic iconic) qualisign	of possibility	of possibility	of possibility
II. (rhematic) iconic sinsign	of possibility	of possibility	of existent
III. rhematic indexical sinsign	of possibility	of existent	of existent
IV. dicent (indexical) sinsign	of existent	of existent	of existent
V. (rhematic) iconic legisign	of possibility	of possibility	of law
VI. rhematic indexical legisign	of possibility	of existent	of law
VII. dicent indexical legisign	of existent	of existent	of law
VIII. rhematic symbol(ic legisign)	of possibility	of law	of law
IX. dicent symbol(ic legisign)	of existent	of law	of law
X. argument (symbolic legisign)	of law	of law	of law

5. *Je ne croy que ce que je voy*[273]

This chapter is largely to inquire about ultra-violet and tinted photography which epitomize pre-Röntgen diagnostic artefacts. Hermann Wilhelm Vogel accidentally noticed dark spots on a *Frau*'s snapshot that could have been some latent precursor of illness: soon, it turned out that she had contracted smallpox. However, such prognostic shortwave-sensitive emulsion remained virtually unknown to or, if ever, rarely embraced by rationalist physicians mostly of German laboratories but were replaced with hand-coloured pictures; neither of them would last historically anyway.

Even before Vogel, medicine and post-daguerreotypical routines converged: doctors welcomed the optical apparatus in order to document freakish maladies or after-effects of treatment. For instance, an injured soldier (Figure 5-1) faces straightforward and full-length, whereas the altered region on his left hip and thigh is exhibited in a rather decorative mirror; we should deserve any close-up of it, had this picture (ascribed to William Bell of Philadelphia, dated 1865 approximately) been taken more clinically as beginning from the *fin-de-siècle*.[274] Yet it does not show what the bullet did internally (e.g. localization, fracture) which becomes a radiological obsession three decades later.[275]

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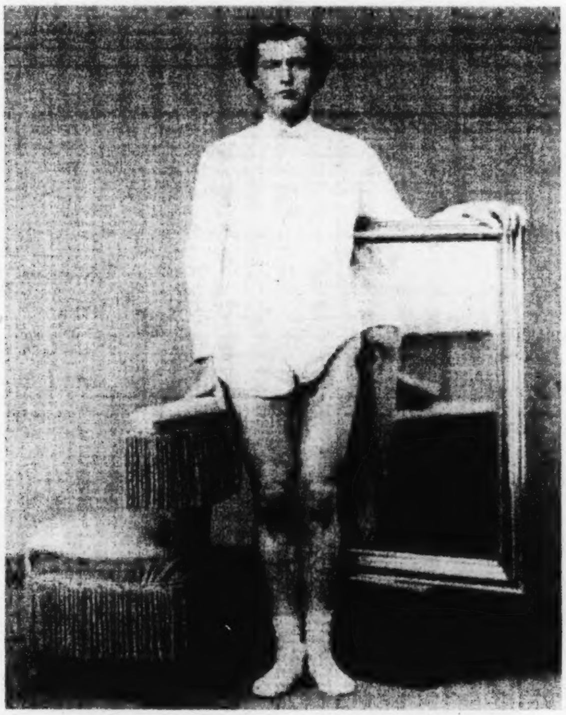
[273] G. Patin, *Lettres 1630-1672* (Paris: Librairie Honoré Champion, 1907), 20; see **3. 2. 3** for an extensive translation.

[274] Andreas-Holger Maehle, "The Search for Objective Communication: Medical Photography in the Nineteenth Century," in *Non-verbal Communication in Science Prior to 1900*, ed. Renato G. Mazzolini (Firenze: Leo S. Olschki, 1993).

[275] For example, Robert Jones and Oliver Lodge, "The Discovery of a Bullet Lost in the Wrist by Means of the Roentgen Rays," *Lancet* 1 (1896, Feb 22): 476-77; John Cox and Robert

In this photo, unfortunately, surgical issues were envisaged with too shallow dermatological cues.

Figure 5-1. A gunshot casualty[276]



Let me pass over three other sorts of medical photography. First off, although psychiatry is still about "inside out, outside looking in," we may illustrate such mental—

C. Kirkpatrick, "The New Photography with Report of a Case in which a Bullet was Photographed in the Leg," *Montreal Medical Journal* 24 (1896, Mar): 661-65; see **6. 1**.

yet behaviourally manifest—interiority differently from the material body: Paul M. L. P. Richer under Dr. Jean-Martin Charcot's direction at Salpêtrière even chose sketched etchings upon their more realistic original pictures.[277] Secondly, photomicrography initiated by Alfred Donné[278] seems like a life science "looking for detail" rather than hands-on medicine. Lastly, the endoscopic topology, since Fritz M. Lange and D. Meltzing built a 2 inch-long camera which digs into the stomach with a tiny lamp,[279] has gone "once deep inside, then looking around" that is reverse to my subtitle of this dissertation.

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[276] In public domain, confirmed by the National Gallery of Canada; reprinted from Anne Marie Todkill, "Anomalies and Anonymity," *Canadian Medical Association Journal* 161 (1999): 420.

[277] P. Richer, *Études cliniques sur la grande hystérie ou hystéro-épilepsie: Avec 197 Figures intercalées dans le texte et 10 gravures à l'eau-forte* (Paris: Adrien Delahaye et Émile Lecrosnier, 1885); see also Georges Didi-Huberman, *Invention of Hysteria: Charcot and the Photographic Iconography of the Salpêtrière* (Cambridge: The MIT Press, 2003).

[278] "Images photogéniques d'objets microscopiques," *Comptes Rendus Hebdomadaires des Séance* 10 (1840): 339.

[279] F. Lange and D. Meltzing, "Die Photographie des Mageninnern," *Münchener Medicinische Wochenschrift* 45 (1898): 1585-88.

5. 1. A failure of 19th-century photography in medical practices[280]

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[280] To be presented at the International Committee for the History of Technology's symposium, Victoria, August 2008. Abstract reads: Hermann Wilhelm Vogel's episode published in 1874 reads: "A lady was photographed at Berlin, whose face had never presented specks in photography. To the surprise of the photographer, on taking her portrait specks appeared that were invisible in the original. A day later the lady sickened of the small-pox, and the specks at first invisible to the eye, became then quite apparent." He had noticed dark spots on the picture of a healthy-looking woman by chance before they actually came out. My inquiry takes hereafter two steps: first, why did the seemingly ultra-violet apparatus that made Vogel see this otherwise latent sign of illness remain unknown to doctors? Our chemist and portraitist would seldom examine patients but merely retouch their snapshot. The medical gazes meant "outside looking in" to him; as per depth, UV can hardly match x-rays, an innovation two decades later. Secondly, regarding temporality, even if Vogel's medium had been known, would those rationalist diagnosticians of German laboratories rather than empiricist prognosticians of French hospitals in that era have welcomed it? Just as Roland Barthes muses about his dead mother's "avoir-été-là" on her funeral picture, so Vogel saw one dying Frau's "sera-là." Both of them are ghostly spectra emanating from each "thanato-graph." All this helps in explaining how some technologies were socially selected yet others not.

> There are faces with little *yellow* specks that do not strike the eye, but which come out very dark in photography. *A few years ago* a lady was photographed at Berlin, whose face had never presented specks in photography. To the surprise of the photographer, on taking her portrait specks appeared that were invisible in the original. *A day* later the lady *sickened* of the *small-pox*, and the specks at first invisible to the eye, became then quite apparent. Photography in this case had detected before the human eye the *pock-marks* very feebly tinged yellow.
>
> –Hermann Wilhelm Vogel[281]

This epigraphed 19th-century text sounds to me as though a portraitist observed certain dots on the picture of a healthy-looking but doomed woman by chance, before they were actually manifested to the naked eye. Herr Vogel, famous for *The Chemistry of Light and Photography*, taught at Prussia's Königliche Gewerbeakademie and died in 1898; his biography recorded by Josef Maria Eder needs corrections.[282] Was Vogel talking about something that reminds us of a crystal ball into which psychics or mystics peer, so as to anticipate whatever shall unfold in the future? Now that there seems like no such too-good-to-be-true equipment around currently; we must have lost it, much to my regret. This paper hereafter attempts to explore why the *pro-gnostic* visual medium made known by Vogel ended up *a-gnosed*: which means, *neglected.*

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[281] *Die chemischen Wirkungen des Lichts und die Photographie in ihrer Anwendung in Kunst, Wissenschaft und Industrie* (Leipzig: F. A. Brockhaus, 1874); translated as *The Chemistry of Light and Photography* (New York: Arno Press, 1973), 65; italicized by me.

[282] J. M. Eder, *History of Photography* (New York: Dover Publications, 1978). It is written that Vogel was born in 1854; then how could he move to Berlin in 1852? Library of Congress data in *The Chemistry of Light and Photography* says "1834-1898" which might be right. Page 463 of Eder reads: "Vogel participated as photographer in the North-German solar eclipse expedition to Aden, in 1868, to Sicily, in 1870, with the British expedition, *in four editions, and many of his articles were translated into foreign expedition,* in 1888, to Jurgewetz on the Volga. [...] His *Handbuch der Photographie* appeared in four editions, and many of his articles were translated into foreign languages" (italicized by me). It should read without that inserted repetition: "Vogel participated as photographer in the North-German solar eclipse expedition to Aden, in 1868, to Sicily, in 1870, with the British expedition, in 1888, to Jurgewetz

5. 1. 1. If looks could kill

I have found this bizarre story via the second part of Alison Gernsheim's two-fold contribution titled "Medical Photography in the Nineteenth Century" to Volume 11 of *Medical & Biological Illustration*, superseded by the *Journal of Visual Communication in Medicine* since 2005, where she wrote:

> The over-sensitivity to *blue and violet* of the early "colour-blind" plates had an advantage in dermatology over ortho or panchromatic material, for the texture of the skin was rendered with greater detail. Hermann Wilhelm Vogel, pioneer of colour sensitizing of photographic emulsions, reported the case of a woman who went to be photographed in *1864*: to everyone's amazement her portrait turned out covered with black spots. *A few days* later she *died* of *smallpox*. The *disease* had been detected by the photographic plate before it became visible to the eye.[283]

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on the Volga. [...] His *Handbuch der Photographie* appeared in four editions, and many of his articles were translated into foreign languages."

Gernsheim did not note Vogel's book *Die chemischen Wirkungen des Lichts und die Photographie* whose Anglo-American translation was initially printed in 1875 as part of D. Appleton and Company's international scientific series. A late British collector like her may have chosen not to identify this reference,[284] which is exceptional in her entire article boasting a bibliography of 46 entries, but instead to correct it. Discrepancies between those two authors lie in whether it was *a few years ago* from the 1874 publication (Vogel) or *1864* (Gernsheim), either the lady/woman *sickened* or *died*, *a day* or *a few days* later, and most significantly whether the faint-enough-to-be-hidden colour was *yellow* or *blue and violet*. Let me quote Vogel in his *Muttersprache* this time for comparison:

> Es gibt Gesichter mit leisen *gelben* Flecken, die dem Auge gar nicht auffallen und die in der Photographie auffallend dunkel zum Vorschein kommen. In Berlin wurde *vor einigen Jahren* eine Dame photographirt deren Gesicht in der Photographie niemals Flecke ergeben hatte. Zur Ueberraschung des Photographen erschienen bei der Aufnahme augenfällige, im Original selbst unsichtbare Flecken. *Einen Tag* später *erkrankte* die Dame an den *Pocken*, und die anfangs für das Auge unsichtbaren Flecken traten jetzt deutlich sichtbare zum Vorschein. Hier

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[283] A. Gernsheim, "Medical Photography in the Nineteenth Century," *Medical & Biological Illustration* 11 (1961): 147; italicized by me.

[284] Or second-handedly, there were U.S. periodicals such as *Boston Journal of Chemistry*, *Medical and Surgical Reporter*, and *Philadelphia Medical Times* as Tanya Sheehan of Brown University indicates.

> hatte die Photographie die (jedenfalls ganz schwachgelb tingirten) *Pockenflecken* früher erkannt als das menschliche Auge.[285]

Despite rather clear fluid and pus inside the papules, a smallpox rash per se is purple on Caucasian skin.[286] However for Vogel who by 1873—either *a few years ago/vor einigen Jahren* from 1874 or *1864*—included green in the list of lights like blue and white to which developing preparations (i.e. sensitive coating upon glass and chemical baths) had been susceptible, anything photographed black might be regarded as

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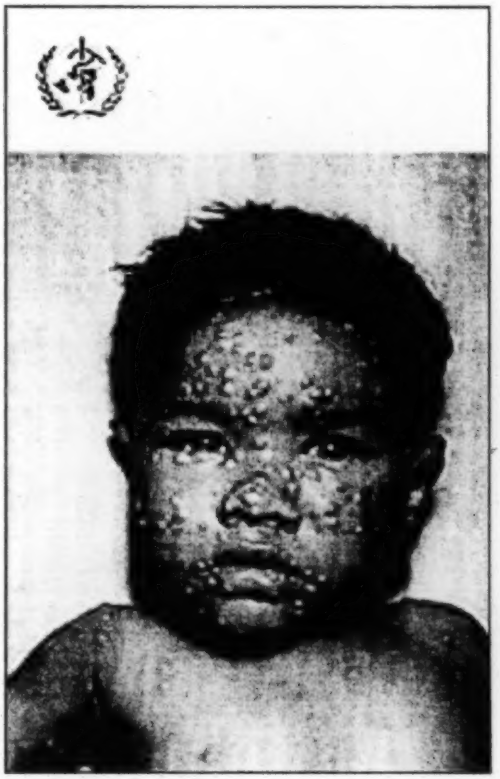
[285] H. Vogel, *Die chemischen Wirkungen des Lichts und die Photographie in ihrer Anwendung in Kunst, Wissenschaft und Industrie* (Leipzig: F. A. Brockhaus, 1874), 61; italicized by me.

[286] It seems *bright yellowish* among people in "endemic countries" of the 1970s, where smallpox still naturally occurred to be colour-pictured as demonstrated on a card (right; http://www.nlm.nih.gov/exhibition/smallpox/sp_obstacles.html, a U.S. National Library of Medicine site). Melanin in the epidermis is a factor.



having a longer wavelength i.e. yellow through red on the rainbow spectrum: "if certain coloured substances that absorb light were added to bromide of silver, which is by itself too little sensitive to green, the sensitiveness of this bromide to green is considerably increased."[287] Limes left no shady impression on the plates, in Vogel's chemistry, while oranges still did. Our professor at the Royal Trade Academy could have confused pox pustules with such pits or even freckles! Unaware of which of the diversely biased solutions was used, I dare to suppose that Vogel's accident should plausibly be about dim blue, violet and/or ultra-violet although he did not associate J. W. Ritter's preceding discovery of energy at such wavelengths; Vogel nonetheless knew about the opaque inscription with sulphate of quinine, perceived as dark in photography. What if this quinine that "has the property of lowering the tone of violet, of ultra-violet and blue rays; that is, of converting them into rays of less refraction and of less chemical effect" was involved in the case of interest?[288] This epidemiological misunderstanding of *small-pox* maybe for *yellow-fever* partially shows why Vogel's findings[289] remained ignored by the contemporary college of medical experts.

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[287] Vogel, *Die chemischen Wirkungen des Lichts und die Photographie*; translated as *The Chemistry of Light and Photography* (New York: Arno Press, 1973), 66.

Were they an intended audience in any case? Vogel admitted the popularity of portraiture: "people go to [a photographer] with some slight *malaise*, with headache, or a restless night. This is a great mistake; the bodily or mental condition stamps itself infallibly on the picture, and often gives it a very dissimilar expression to the original" subject.[290] The aforementioned case of *Pockenflecken/pock-marks* warranted erasure by

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[288] Vogel, *The Chemistry of Light and Photography*, 67. Jeanette Buckingham at the John W. Scott Health Sciences Library, University of Alberta, has agreed with my interpretation. Robin and Gigi Williams called the ray "blue/*ultra*violet" rather than "blue/violet" while referring to Gernsheim; Williams and Williams, "Hermann W Vogel," Pioneers of Invisible Radiation Photography, http://msp.rmit.edu.au/Article_04/05.html.

[289] Is this episode Vogel's own? The surprised "photographer" could be either himself (Williams and Williams; cf. the third-person "writer of this work [...] He found" in Vogel, *The Chemistry of Light and Photography*, 66) or someone else with, as David Bryson at the University of Derby believes, Vogel giving an indirect account.

[290] Vogel, *The Chemistry of Light and Photography*, 151.

the portraitists[291] rather than physicians' attention: "Sorry ma'am for our fault; your beauty is impeccable." Those intimate with such photography, although still a young technology, had to mistrust its verisimilitude—how ironic![292]

5. 1. 2. Ultra-violet: in the flesh, under the skin?

Approximately a century later, or four decades after Robert Williams Wood manufactured ultra-violet photos of the human skin inspired by nocturnal military interests,[293] Alison Gernsheim recognized "an advantage in dermatology" of whatever Hermann Wilhelm Vogel had experimented on "for the texture was rendered with greater detail."[294] Aiming at this value, today's clinicians apply UV technology up close onto *in vivo* bodies when suspecting tone or colour changes which are too slight to be discernible by the naked eye.

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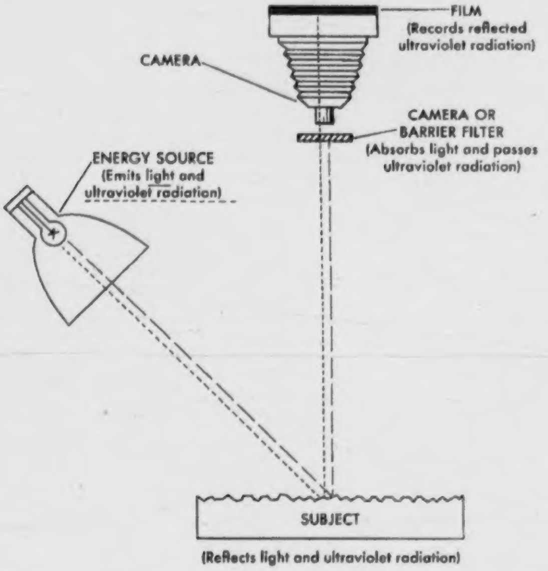
[291] Yun-Csang Ghimn, "Realities Retouchable? On-the-surface Conventions from Camera Obscura to Ultrasound" (paper to be presented at the Society for the History of Technology annual conference, Lisbon, October 2008).

[292] Donald Mackenzie, *Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance* (Cambridge: The MIT Press, 2000), 371.

[293] R.-W. Wood, "Communications secrètes au moyen de rayons lumineux," *Journal de Physique Théorique et Appliquée* 5e série, tome IX (1919): 87.

[294] A. Gernsheim, "Medical Photography in the Nineteenth Century," *Medical & Biological Illustration* 11 (1961): 147.

Figure 5. 1. 2-1. Set-up of UV imaging[295]


FILM
(Records reflected ultraviolet radiation)
CAMERA
CAMERA OR BARRIER FILTER
(Absorbs light and passes ultraviolet radiation)
ENERGY SOURCE
(Emits light and ultraviolet radiation)
SUBJECT
(Reflects light and ultraviolet radiation)

One should select a mercury lamp (Figure 5. 1. 2-1) with quartz optical components—since conventional glass block every discharge below 350 nm—over a non-artificial solar source. Once hitting its target subject, UV is reflected from the epi-/dermal levels (see Figure 5. 1. 2-2) while visible beams would break through: hence UV pictures look sharper there. I would think it is the same principle that *sky*-blue photons get more scattered up in the air and, via consequently prolonged paths, better absorbed whereas others reach the earth. UV-B rays (280-320 nm) can help a number of pigments synthesize vitamin D but also harmfully burn Deoxyribo-Nucleic Acid to induce cancer, and UV-A (320-400 nm) are taken in strongly by chromophores in oxy-/haemoglobin within small hypodermic capillary veins.

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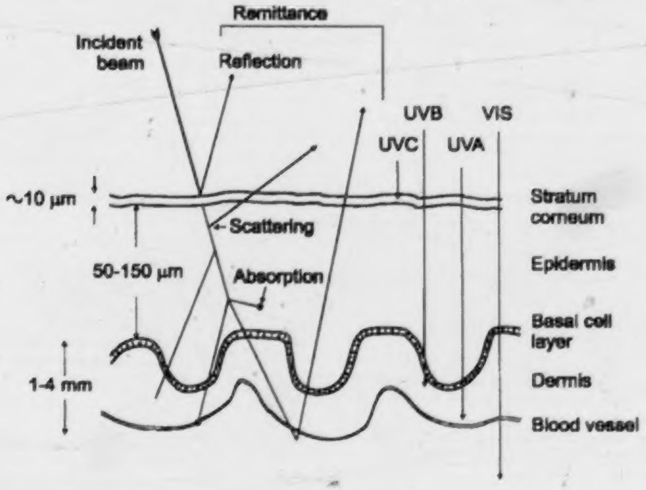
[295] Henry Louis Gibson, *Medical Photography; Clinical-ultraviolet-infrared* (Rochester: Eastman Kodak Company, 1973), 123; reprint with permission by Eastman Kodak Company.

Figure 5. 1. 2-2. UVC, UVB, UVA and visible lights' penetration[296]



Rays tend to focus farther from where they have started, as the wavelength gets longer (Figure 5. 1. 2-2). Yet, lenses for the camera would therefore shift that positive ratio to a U-curve peaking negatively at 550 nm i.e. green,[297] which reverses the gap in focal length between UV and usual full-aperture photography, and thus engenders fuzziness in the visible-light wavelengths. More adjustments are necessary for an enhanced definition[298] because coated post-war lenses have eliminated the UV band. Instead, one employs exciting filters (see Figure 5. 1. 2-1) named after Wood to screen any unwanted radiation but to prefer UV transmission so that vitiligo (Figure 5. 1. 2-3) and other skin disorders can be depicted more distinctively. Though most films might catch UV, colour materials end up confusing it with blue.[299]

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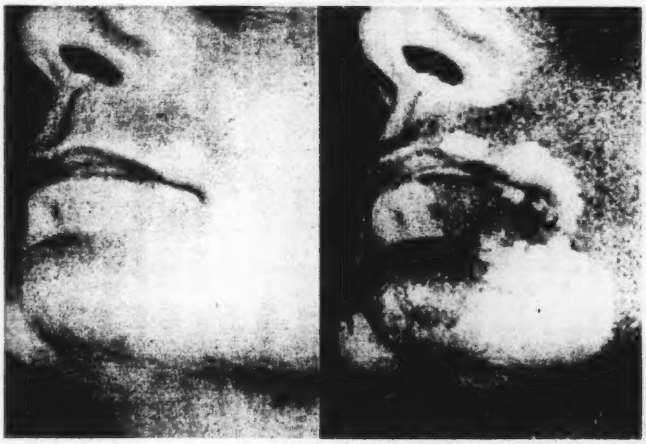
[296] Johan Moan, "Visible Light and UV Radiation," in *Radiation at Home, Outdoors and in the Workplace*, eds. Dag Brune et al. (Oslo: Scandinavian Science Publisher, 2001), 80; permission by Scandinavian Science Publisher and the author.

[297] Infra-red rays above 750 nm go deeper without such compensation. Then what if Vogel utilized not UV- but IR-active stuff to watch the reddish rash? That was no suggestion by Gernsheim or Robin and Gigi Williams.

Figure 5. 1. 2-3. Control (left) vs. UV photos exhibiting depigmentation[300]



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[298] C. R. Arnold et al., *Applied Photography* (London: Focal Press, 1971), 268-69.

[299] Stephen Wreakes, photographer at the University of Alberta Hospital, uses monochromatic emulsions like Kodak T-Max which has a relatively high UV responsiveness.

[300] Ray J. Lunnon, "Clinical Ultraviolet Photography," *Journal of the Biological Photographic Association* 36, no. 2 (1968): 74; on http://msp.rmit.edu.au/Article_04/11.html.

However, the shallow UV must not have been satisfactory for diagnostic purposes, even to Vogel who appreciated only tools which might enable him to gaze at the "impenetrable interior of living organs."[301] No wonder *Mediziner am Ausgang des Jahrhunderts* embraced nothing less, i.e. as per depth, than Wilhelm Conrad Röntgen's leap ahead into non-invasive anatomy: radiological images. Is it a coincidence that the inventions of x-rays and UV plate originated from physics and chemistry?

Deutsch *medical science* had been housed in university laboratories since *Die Cellularpathologie* [1858] by Rudolf Ludwig Karl Virchow, so the German erudite researched mere *samples* isolated from a real person. Situations might have been different for UV previously in—but not earlier than—Parisian training centres.[302] Hence, to me, some epistemological novel trend of *teutonische Doktoren* over hands-on *Ärzte* would emerge several decades after the great French clinical school was established: curing *médecins* considered *sick-bed* performances including pathological observation as their job again.[303] To the question "Where does it hurt?"[304] Marie François Xavier Bichat began the 19th century by answering: "*on* the flat tissue."[305] Giambattista Morgagni in 1761, on the other hand, said: "*in* the bulky viscera."[306] There at post-revolutionary institutions for teaching like the Hôtel Dieu housing individuals similar enough to categorize together, our body was deemed as layered[307] and induction to a limited extent—with some degree of precision—became viable with "very many times," as Claudius Galen (129~216 A.D.) had put it,[308] to study the same cases of malady.

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[301] H. Vogel, *Die chemischen Wirkungen des Lichts und die Photographie in ihrer Anwendung in Kunst, Wissenschaft und Industrie* (Leipzig: F. A. Brockhaus, 1874); translated as *The Chemistry of Light and Photography* (New York: Arno Press, 1973), 202.

[302] Erwin H. Ackerknecht, *Medicine at the Paris Hospital, 1794-1848* (Baltimore: Johns Hopkins Press, 1967).

[303] Hippocrates' first aphorism goes: "Life is short, the art (*τεχνη*) long," as he taught non-aesthetic skills for emergency, "opportunity fleeting, experiment treacherous, judgment (*κρισις*) difficult. The physician must be ready, not only to do his duty himself, but also to secure the co-operation of the patient, of the attendants and of externals."

Another precedent of calling medicine *techne* is Socrates' in Plato, *Gorgias* (London: William Heinemann, 1961), 462B-66A.

5. 1. 3. U gonna die anyway

> A photographic knowledge of the world is cruel. This is because the power of photography consists in creating sudden death, and in lending to objects and

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	genuine crafts		flatteries
soul	politics	justice	rhetoric
		legislation	sophistry
body	*healing*		cookery
	gymnastic		self-adornment

[304] Michel Foucault, *The Birth of the Clinic: An Archaeology of Medical Perception* (New York: Pantheon Books, 1973), xviii.

[305] X. Bichat, *Traité des membranes en général et de diverses membranes en particulier* (Paris: Méquignon-Marvis, 1827).

[306] G. B. Morgagni, *The Seats and Causes of Diseases Investigated by Anatomy* (Birmingham: Classics of Medicine Library, 1983).

[307] R. Virchow did not refute the notion and wood-engraved illustrations of tissue in his second through third lectures; *Cellular Pathology as Based upon Physiological and Pathological Histology* (Birmingham: The Classics of Medicine Library, 1978), 24-71. We still say, just like "liver damage" simply, for example, "liver *tissue* damage."

[308] Galen, *On Medical Experience* (London: Oxford University, 1944), 96-98.

> beings the traditional mystery that gives death its romantic force. The camera's click suspends life in an act that the developed film reveals as the very essence.
>
> –Pierre Mac Orlan, 1930[309]

Who, by the way, would have fearlessly examined sufferers of smallpox, a disease so communicable through the respiratory tract that no physical contact with open lesions or biocontaminated objects is needed? A young male photographer at Birmingham University's medical school became on February 18, 1966 the first victim of variola minor that affected 73 residents. Having already been vaccinated, Mrs. Janet Parker (another photographer) became infected by the variola major virus, which had escaped from Dr. Henry S. Bedson's lab at the microbiology department, dying 47 days later in 1978 when the World Health Organization was announcing *global* eradication.[310]

Likewise with no feasible treatment for such diseases, Hippocrates around 400 B.C.[311] postulated a diachronic approach: a series of periods to be verified through events that happen intermittently to the individual. "Fevers come to a crisis on the same days, both those from which patients recover and those from which they die. The mildest fevers, with the most favourable symptoms, cease on the fourth day or earlier. The most malignant fevers, with the most dangerous symptoms, end fatally on the fourth day or earlier. The first assault of fevers ends at this time; the second lasts until the seventh day, the third until the eleventh, the fourth until the fourteenth, the fifth until the seventeenth, and the sixth until the twentieth day."[312]

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[309] "Preface to *Atget photographe de Paris*," in *Photography in the Modern Era: European Documents and Critical Writings, 1913-1940*, ed. Christopher Phillips (New York: The Metropolitan Museum of Art, 1989), 43.

[310] Abbas Meshkat Behbehani, *The Smallpox Story: In Words and Pictures* (Kansas City: The University of Kansas Medical Center, 1988).

[311] Yun-Csang Ghimn, "A Formation of Classical Orientalism: Or, How the Hippocratic Writer(s) Dealt with the *Other*" (presented at the Canadian Communication Association, Toronto, May 2002).

On which ground did Hippocrates dare assert this? My answer draws upon the hypothetico-deductive method Charles Sanders Peirce, a semiotic heir of Hippocrates, called *abduction* etc. According to Peirce: confined to too small an amount of information to synthesize, we ordinarily have the courage to intuitively speculate notwithstanding its fallibility. Such a tentatively attained principle reveals, in turn, novel phenomena.[313] Now for Hippocrates, it should suffice to take a case history and guess while entering the next phases. He started with a clue, conjectured and endeavoured to correct that during trivial practices. At the final stage of this syllogism, how was the accuracy of such a non-random but arithmetically—1, 4, 7, 11, 14, 17, 21—fixed schedule guaranteed? Counter-evidence seems rarely possible: no matter what followed, "better or worse," he would say *critical*.[314]

Galenists like Jean Fernel [1548][315] and Bartolomeo Eustachi who allegedly maintained a radical position that it was more proper to err with the millennial authority than be right with others, both in the 16th century, have challenged this medical empiricism or its precursor. Hippocrates the charlatan (*εμπειρικος*) did not name diseases; Galenic dogmatists pigeonholed data (i.e. diagnosis) and labelled each syndrome quickly (i.e. nosography). Hearing coughs, for instance, Hippocrates may infer *throat* irritation or *chest* discomfort, identified naively with "the seat of pain,"[316] yet none of those catalogued entities ranging from influenza to tuberculosis. Touching a lump inside her own breast, a Hippocratic pathologist would ask "How long shall I suffer?" (i.e. prognosis) without the six-letter word of *cancer*. Being modern themselves, Hermann Wilhelm Vogel[317] and Alison Gernsheim[318] both mentioned *Pocken/smallpox* not its painful symptoms such as fever, chills, head and muscle aches; it sounds not to be flat smallpox if lesions projected above the surface but fulminant one that causes certain death within a week, although the victim must have prostration or vomiting—so typical for diagnosis. Whether the lady *erkrankte/sickened* or *died*, they blamed that disease rather than complications including pneumonia and haemorrhage.

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[312] Hippocrates, *Prognostic* (London: William Heinemann, 1959), chapter 20.

[313] C. S. Peirce, *Collected Papers* (Cambridge: Harvard University Press, 1931-35 & 1958), Volume VI, paragraph 526-36 (citation is to *CP* Volume. paragraph).

[314] Hippocrates, *Epidemics* (London: William Heinemann, 1972), book I, paragraph 26.

Such indifferent rationalism has been the Western mainstream[319] since Galen the Roman (a character himself paradoxical enough to combine both intellectualist and

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[315] *On the Hidden Causes of Things: Forms, Souls and Occult Diseases in Renaissance Medicine* (Leiden: Brill, 2005).

[316] Sophocles, *Antigone* (London: William Heinemann, 1928), 318.

[317] *Die chemischen Wirkungen des Lichts und die Photographie in ihrer Anwendung in Kunst, Wissenschaft und Industrie* (Leipzig: F. A. Brockhaus, 1874), 61; *The Chemistry of Light and Photography* (New York: Arno Press, 1973), 65.

[318] "Medical Photography in the Nineteenth Century," *Medical & Biological Illustration* 11 (1961): 147.

[319] Harris L. Coulter, *Divided Legacy: A History of the Schism in Medical Thought, v. I. The Patterns Emerge: Hippocrates to Paracelsus* (Washington: Wehawken Book, 1975).

practical tenets by deriving the *logos* from his face-to-face attention towards signs and embracing an impromptu judgement to be confirmed or refuted during routine exercises, whom one should not identify with Galen's post-classical extremist heirs though) where I find no exceptions in Vogel's understanding of this case and Gernsheim's interpretation thereof: which echo other twentieth-century visual technologies—diagnostic or not: Diane Arbus said, "it's impossible to get out of your skin into somebody else's. And that's what all this is a little bit about. That somebody else's tragedy is not the same as your own."[320] My thesis should clarify her point which sounds applicable for nuclear magnetic resonance imaging and positron emission tomography also.

Let me once again express doubt: without a viable cure but only palliative care for smallpox then and even now, why do we bother to forecast its aggravation? Probably the kindest thing one could say to that pitiful woman is, in a voice of relief: "You will feel no pain soon." Indeed, nor is there life to feel anything either. The ominously spotted picture might be hung for her funeral service like that of Madam Barthes, mourned over by her son Roland: "If photography is to be discussed on a serious level, it must be described in relation to death. It's true that a photograph is a witness, but a witness of something that is no more. Even if the person in the picture is still alive, it's a moment of this subject's existence that was photographed, and this moment is gone."[321] His theories, varying from that of mimesis (or images documenting their referent)[322] to cultural and social connotation as much as languages have,[323] repeated Walter Benjamin's[324] for bereavement: the snapshot is so overcast with death.[325] Or in Charles Sanders Peirce's vocabulary concerning photography, *iconicity* disappears at every instant[326] yet *indexical* traces remain.[327] In portraiture, a person's "avoir-été-là" or the ghostly *spectrum* emanating from a woman[328] has been stuck behind i.e. upon the emulsions. Such an enigmatic picture comprises *indexical* adherence plus, by virtue of some properties, vivid *iconic* analogy to prior experience.[329] A far better quotation should be from Susan Sontag as follows:

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[320] *Diane Arbus* (Millerton: Aperture, 1972), 2.

[321] R. Barthes, "Sur la Photographie," in *Œuvres complètes, t. V* (Paris: Éditions du Seuil, 2002; citation is to *ŒC Tome. Livre*/"Texte"/"Entretien"); translated in *The Grain of the Voice: Interviews 1962-1980* (New York: Hill and Wang, 1985), 356.

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[322] *ŒC I*. "Le Message photographique"; translated in *Responsibility of Forms: Critical Essays on Music, Art, and Representation* (Berkeley: University of California Press, 1991).

[323] René Lindekens, *Essai de sémiotique visuelle—Le Photographique, le filmique, le graphique* (Paris: Éditions Klincksieck, 1976), 51 ff.

[324] Eduardo Cadava, *Words of Light: Theses on the Photography of History* (Princeton: Princeton University Press, 1997).

[325] Christian Metz, "Photography and Fetish," in *OverExposed: Essays on Contemporary Photography*, ed. Carol Squiers (New York: The New Press, 1999), 213-15.

[326] W. Benjamin, "Lehre vom Ähnlichen," in *Gesammelte Schriften, Bd. II* (Frankfurt am Main: Suhrkamp Verlag, 1972-90; citation is to *GS Band.* "Titel"); translated in *New German Critique* 17 (1979): 65-69.

[327] *GS I*. "Das Paris des Second Empire bei Baudelaire"; in *Charles Baudelaire: A Lyric Poet in the Era of High Capitalism* (London: NLB, 1973).

[328] *ŒC V*. *La Chambre claire*, 795-96; as *Camera Lucida: Reflections on Photography* (New York: Hill and Wang, 1981).

[329] *CP* IV. 447.

> Photography is the inventory of mortality. A touch of the finger now suffices to invest a moment with posthumous irony. Photographs show people being so irrefutably *there* and at a specific age in their lives; group together people and things which a moment later have already disbanded, changed, continued along the course of their independent destinies. [...] Photographs state the innocence, the vulnerability of lives heading toward their own destruction, and this link between photography and death haunts all photographs of people.[330]

In summary, Vogel could not help looking blankly at one pestilence-contracted *Frau*'s mortal *sera-là* i.e. *going to be there* dead, to which all observers succumb on the presumably ultraviolet photo-, or as I would name it, *thanato-graph*. First off, Vogel's poor knowledge of epidemiology was unacceptable; did he ever make a serious effort to convince doctors? Secondly but no less importantly, disciplinary apathy in medicine is such that they still prefer early specimen-based diagnosis of a disease to prognosis about the symptoms. Too bad such a common yet looks-could-kill contagious malady was at issue whose victims Vogel or anyone else might seldom have confronted, let alone been able to heal. Instead, hand-tinted photography[331] succeeded these seemingly predictive UV-sensitive plates in the adoption for smallpox to my disappointment.

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[330] S. Sontag, *On Photography* (New York: Anchor Books, 1990), 70.

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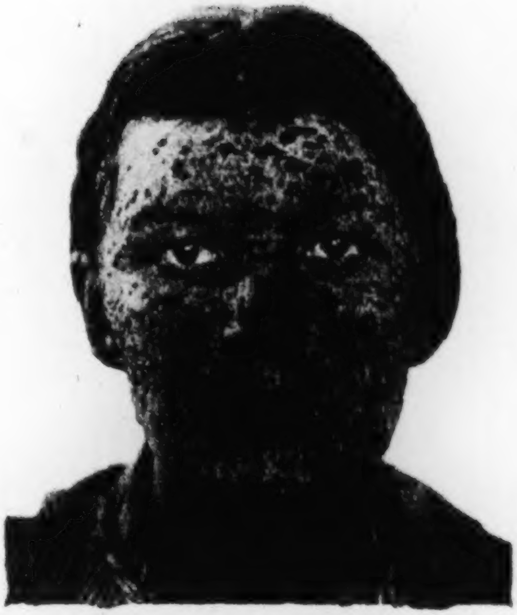
[331] George Henry Fox, *A Practical Treatise on Small-pox* (Philadelphia: Lippincott, 1902; on http://www.library.ucla.edu/libraries/biomed/smallpox/effects.html).



5. 2. On-the-surface conventions from camera obscura to ultrasound[332]

5. 2. 1. Manually tinted photography

> In order to reproduce in color certain negatives requiring special demonstration, the services of Félix Méheux, *dessinateur et photographe* of the Hôpital Saint-Louis, Paris, have been secured, whose life-like illustrations in Chatelain's admirable work on diseases of the skin have sufficiently introduced him to the medical profession. –William Thomas Corlett

Textbooks on dermatology have been published since the mid-19th century, recording actual case studies on patients suffering from non-respiratory-transmitted hence looks-couldn't-kill syphilis etc.[333] Hermann Wilhelm Vogel's potentially shortwave-positive emulsion, via which he amazingly witnessed otherwise invisible specks i.e. a latent sign of illness on the facial portrait of a healthy lady at Berlin, was replaced when Corlett of Cleveland invited Monsieur Méheux to render images quite *realistic*. What this Parisian did is to use a paintbrush upon monochrome pictures, so now we clearly observe colours.

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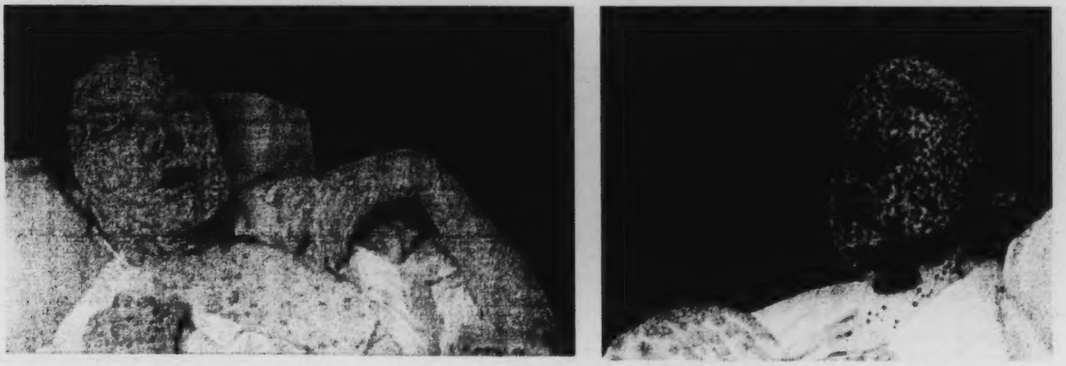
[332] To be presented with **5. 1** at the Society for the History of Technology conference, Lisbon, October 2008; main-titled "Realities Retouchable?"

[333] Or see Balmanno Squire, *The Treatment of Lupus* (London: J. A. Churchill, 1897).

Figure 5. 2. 1-1. Case of smallpox, eighth (left) and twelfth days of eruption[334]



5. 2. 2. Camera obscura-influenced engraving

> A very essential advantage of [*Anatomia uteri humani gravidi tabulis illustrata*] is, that as it represents what was actually seen, it carries the mark of truth, and becomes almost as infallible as the object itself [...] especially if the work be conducted by an anatomist who will not allow the artist to paint from memory or imagination, but only from immediate observation. –William Hunter[335]

One may wonder how it could have even been possible to claim automatic transparency, when the human left obvious traces, working upon diagnostic visualization; i.e. where those painters' manipulative hands returned to expose themselves between supposedly technical pictures derived from their natural referent and us who should, as insisted by Vilém Flusser,[336] doubt such naïve mechanical causality. Nevertheless, retouching per se was hardly new.[337] Through a pin-hole, the sunshine comes—particularly on fine days—into a proto-photographic box named "camera obscura" (Figure 5. 2. 2-1) meaning *dark room*, so that scenes in front appear upside down—or the skeleton hanging inverted for simpler tracing (no extra few lenses therein) now straight up. William Cheselden, a surgeon cum draughtsman, or his assistant superimposed details upon the table glass with a pencil employing dots, hatches and undulations so as to deliberately emphasize the matte texture. Cheselden's staff engravers, Gerard van der Gucht and Mr. Shinevoet, then executed many copperplate illustrations—a superior material with higher definition if enough pressure for printing was available.

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[334] W. T. Corlett, *A Treatise on the Acute, Infectious Exanthemata: Including Variola, Rubeola, Scarlatina, Rubella, Varicella, and Vaccina, with Especial Reference to Diagnosis and Treatment* (Philadelphia: F. A. Davis Company, 1902).

[335] Preface to *The Anatomy of the Human Gravid Uterus Exhibited in Figures* (Birmingham: Classics of Medicine Library, 1980).

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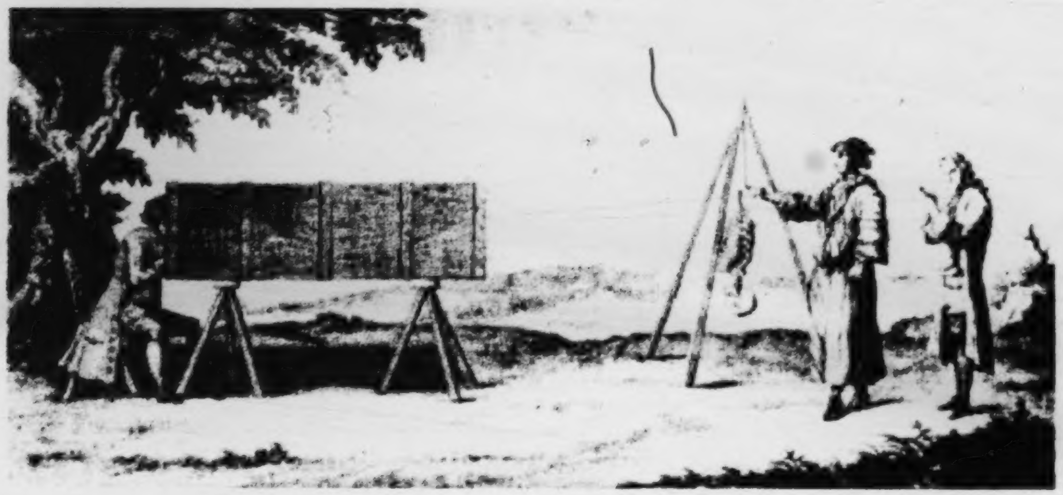
[336] *Towards a Philosophy of Photography* (London: Reaktion Books, 2000), 14-32; because this pamphlet carries no citations or bibliography, arguments may not be Flusser's original admittedly e.g. *symbolicity* of apparatus-produced images (see **5. 1. 3**).

[337] Also see Andreas-Holger Maehle, "The Search for Objective Communication: Medical Photography in the Nineteenth Century," in *Non-verbal Communication in Science Prior to 1900*, ed. Renato G. Mazzolini (Firenze: Leo S. Olschki, 1993).

Figure 5. 2. 2-1. Title page of Cheselden's *Osteographia, or the Anatomy of the Bones* [1733][338]



His obstetrical student, Hunter (see **4. 2. 3**) of Scotland had the same preoccupation—rendering tactility.[339] It was a precursor to Marie François Xavier Bichat's *tissue* pathology which regards the human body three-dimensional, consisting of layered surfaces. Before that, we had Giovanni Battista Morgagni's *organ* medicine. I could thus compare the duo of Hunter and Bichat concentrating upon superficiality respectively with Bernhard Siegfried Albinus of Frankfurt, professor at Leyden who not only polished the bones all-bright (he acquired just one set of skeleton and pickled it to last for 3 months) but added some grey background containing a rather distracting rhinoceros to preserve the proper light upon his dramatizing subject,[340] and Morgagni—as if theory was driven by its display.

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[338] Cheselden might be peering into that instrument or standing beside the skeleton; refer to Sir Zachary Cope, *William Cheselden, 1688-1752* (Edinburgh: E. & S. Livingstone, 1953).

[339] On his sketcher, see John L. Thornton, *Jan van Rymsdyk: Medical Artist of the Eighteenth Century* (Cambridge: The Oleander Press, 1982).

Table 5. 2. 2-1. Folios antedating viscera/tissue pathology

1747	1761	1774	1793	1800
	Morgagni, *De sedibus et causis morborum*			Bichat, *Traité des membranes*
			Matthew Baillie,[341] *Morbid Anatomy of Some of the Most Important Parts of the Human Body*	
Albinus, *Tabulae sceleti et musculorum corporis humani*, IV 		Hunter, *Uteri humani gravidi* (http://www.nlm.nih.gov/exhibition/historicalanatomies/Images/1200_pixels/Albinus_t04.jpg)		

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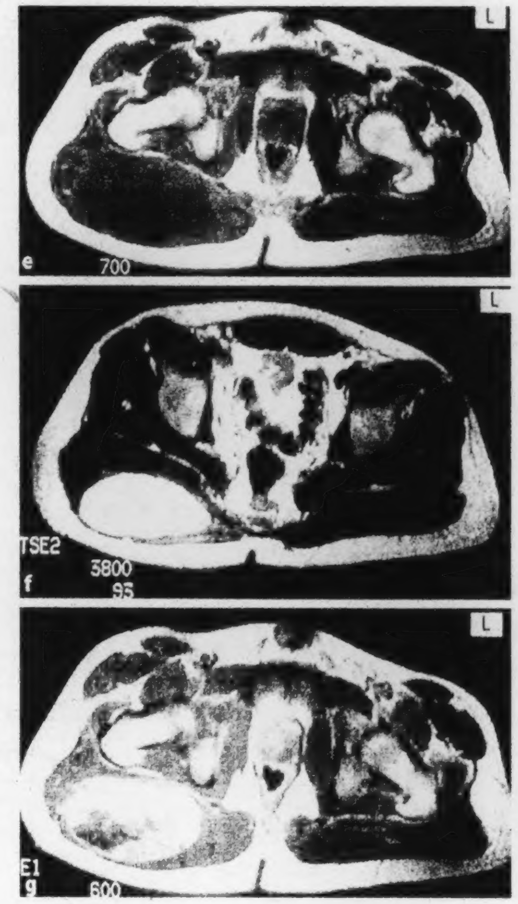
[340] This convention of including landscapes, not similarly intended though, featured in pre-Vesalian atlases e.g. Jacopo Berengario da Carpi, *A Short Introduction to Anatomy* (Chicago: University of Chicago Press, 1959). With three depths—a foreground plant, the dead raised (no sick cured) and everything behind it—Albinus' focus was on the human proportions; his Dutch artist Jan Wandelaer copied along two wire-grid screens, hiring a nude model for comparison.

[341] Hunter's nephew.

5. 2. 3. Tissue characterization vs. colour processing

Radiologists have collaboratively developed algorithms relying upon statistical decision theory among others for the Cheseldeno-Hunterian discrimination of textures which help, if not drastically surpass, expert clinicians' detection.[342] In three nuclear MR tomographs, we get a better i.e. rougher look top-down at some lump that is located bottom left by a homogeneous signal intensity (f) and marked enhancement after gadolinium injection (g; right).

Figure 5. 2. 3-1. Sarcoma of the buttock[343]



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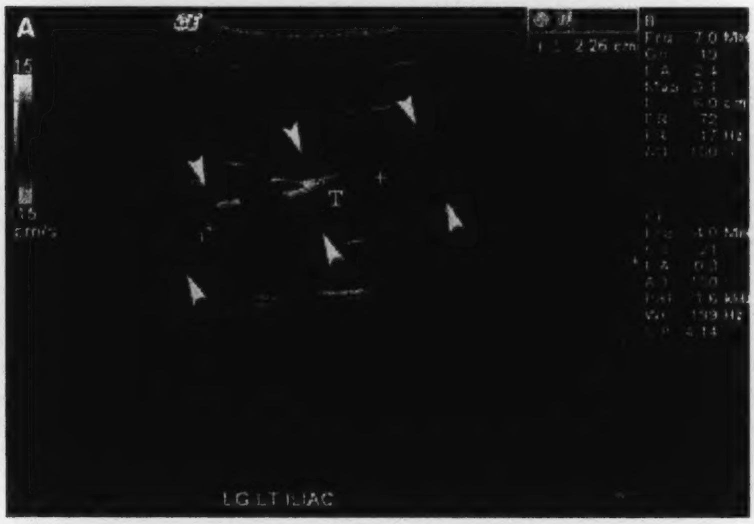
[342] Milan Sonka et al., *Image Processing, Analysis, and Machine Vision* (Toronto: Thomson Learning, 2008), 718-49.

[343] A. M. De Schepper et al., "Magnetic Resonance Imaging of Soft Tissue Tumors," *European Radiology* 10 (2000): 213-22; Fig. 3e-g, with kind permission of Springer Science and Business Media.

A woman in her 30s has groin pain, and we find certain abnormal blood flow around the clot (Figure 5. 2. 3-2); how colourful that is! Charles Sanders Peirce would have called it *diagram*, a subdivision of *icon*.[344] This signifies a degree or quantity from yellow to light blue, *unreal* like Félix Méheux et al.'s painting.[345]

Figure 5. 2. 3-2. Ultrasound scan of isolated deep vein thrombosis[346]



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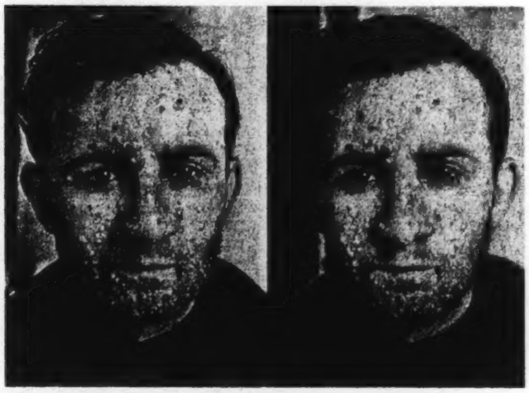
[344] C. S. Peirce, *Collected Papers* (Cambridge: Harvard University Press, 1931-35 & 1958), Volume VI, paragraph 471.

[345] Vilém Flusser says "black-and-white photographs are more concrete" in *Towards a Philosophy of Photography* (London: Reaktion Books, 2000), 44.

[346] Reprinted from *Radiologic Clinics of North America, 42*(2), James D. Fraser & David R. Anderson, Venous protocols, techniques, and interpretations of the upper and lower extremities, p. 280, © 2004, with permission from Elsevier.

Yet, just because semiotic representations are viable only *in some capacity* according to Peircianism (see **7. 2. 1**) does not mean that every instance of synecdoche is equal. We should thus ask further, based on a given era's visual culture, what aspects to pick out of the human body—either its texture or colours. For dermatological practitioners and students, Dr. Selden Irwin Rainforth created slides using a 5" X 7" camera equipped with two lenses that slightly different images, just as our eyes capture the same object separately, are merged to make a three-dimensional perception. The pair of such lithographs was hand-tinted (Figure 5. 2. 3-3) so we see fore-background depth but not much texture.

Figure 5. 2. 3-3. Variola of the face[347]



All episodes in this chapter help explaining why some technologies were selected but others not, e.g. Hermann Wilhelm Vogel's ultraviolet-sensitive medium remained unwelcome to physicians; had it been ever known, these rationalists would have ignored that.

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[347] S. I. Rainforth, *The Stereoscopic Skin Clinic: An Atlas of the Diseases of the Skin* (New York: Medical Art Publishing, 1910), card 126; Courtesy of the National Museum of Health and Medicine, Armed Forces Institute of Pathology, Washington.

6. Initially *indices*: x-rays

6. 1. *Röntgenstrahlen*

> Professor Mosetig, of Vienna, has taken *photographs* which showed with the greatest clearness and precision the injuries caused by a revolver shot in the left hand of a man and the position of the small projectile.
>
> –*British Medical Journal*, February 1, 1896 (italicized by me)

The urge to peer into human bodies' hidden mysteries so as to make them perceptible, e.g. deeply embedded foreign objects, demanded a mutilation of divinely given life and was therefore forbidden historically (see **4. 2. 1 & 2**). When physicians could visualize a patient's anatomical recesses without transgressing her or his skin for the first time, enthusiasm and fascination followed—a reverse side to sin.

Wilhelm Conrad Röntgen found during tests with vacuum tubes at his laboratory on November 8, 1895 that "x-rays" are emanated from the cathode.[348] This highly peculiar form of energy (neither subject to refraction nor magnetically deflected so he could not pinpoint its properties otherwise) pass through certain various opaque substances like flesh to leave *inscriptions* upon an ordinary dry or sensitive film placed behind: "that the density alone does not determine the transparency is shown by an experiment."[349]

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[348] Thus it was seldom that, owing to some xenophobia, Anglophones have creatively said *radiology* or *x-rays* instead of his German umlauted name.

People had employed photography in replicating mechanical images similar to superficial appearances which they observed ably with the naked eye: this nineteenth-century medium had become a model for positivist epistemology (see **Chapter 5**). On the contrary, x-rays disavowed this external correspondence and helped *outside looking in* by illustrating data of three-dimensional phenomena that were just as much authentic but hardly legible or verifiable *per se*—unless you open corpses etc. There is no *light* used in radiologists' *photo*-graphs! Yet this imperfect semantic association went almost uncontested.

Scientists and even trained doctors had difficulty with deciphering such abstract pictures so they relied upon expert technicians. Bernike Pasveer argues that all those professions or "x-ray workers" involved construct the particular meaning of roentgenographic signs contextually[350] by practicing trial and error, comparisons with post-mortem (hence recourse to invasive technology) or translations from other information sources e.g. heart and lung percussion.[351]

By today's standard, the quick dissemination of this novelty seems astounding; though our Bavarian physicist Röntgen did not mention any health-related purposes, an increasing flood of reports within 1896 confirmed how valuable his announcement is and pointed towards medical applications.[352] Diagnostics and surgery were destined to parallel the evolution of this newly enhanced agent's uncanny potential for revelation, and to enrich further research. It not only aroused scientists to such an immediate pitch of excitement, but also rapidly took root in popular culture.[353]

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[349] W. C. Röntgen, "On a New Kind of Rays," *Nature* 53, no. 1369 (1896): 274-76.

[350] B. Pasveer, "Knowledge of Shadows: The Introduction of X-ray Images in Medicine," *Sociology of Health & Illness* 11 (1989): 360-81.

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[351] Hugo Roesler, *Clinical Roentgenology of the Cardiovascular System* (Springfield: C. C. Thomas, 1943), 133-35; see also **Chapter 3**. While early pioneers had often irradiated their own bony limbs, chest radiology understandably lagged behind.

[352] No fewer than 49 books and 1044 notes or articles on the subject were counted by George Sarton, "The Discovery of X-rays," *Isis* 26 (1937): 349-64.

[353] For radiological sensationalism in Britain, see Allen W. Grove, "Röntgen's Ghosts: Photography, X-rays, and the Victorian Imagination," *Literature and Medicine* 16 (1997): 141-73.

6. 2. The year of x-ra(y)/ted mysticism[354]

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[354] Published in *Inter: A European Cultural Studies*, eds. Johan Fornäs and Martin Fredriksson (Linköping: Linköpings universitet, 2007). © The Author, subtitled "A Media Archaeological Perspective." Abstract reads: The early modern concept of *communicatio*—i.e. "action from a distance" such as Locke's association by *deus ex machina* and Newton's general attraction—returned in the late 19th century, getting aroused not only by science but also technologies for example "spirit" photography and Roentgen's discovery. Edison attempted to penetrate the skull and Jordan to capture thoughts on a "psychic retina," both in vain. These are more than hoaxes since, without people's fascination over extrasensory perception, Jordan e.g. could not have rhetorically validated his investigation merely by adopting radiological credibility; how do we explain this wishful expectation? Huhtamo et al.'s media archaeology undertakes "first, the study of the cyclically recurring elements and motives underlying and guiding the development of media culture; second, the 'excavation' of the ways in which these discursive traditions and formulations have been 'imprinted' on specific media machines and systems in different historical contexts, contributing to their identity in terms of socially and ideologically specific webs of signification." Hence depicting medical or everyday media as ones for any unknown world (or mediums) remains consistent in many Japanese horror films—*Cure* (phonographic record), *Ring* (video tape), *Pulse* (internet), *Dark Water* (instant picture), *One Missed Call* (mobile phone).

> I may be asked whether my theory would be favorable or otherwise to telepathy. I have no decided answer to give to this. […] The psychological phenomena of intercommunication between two minds have been unfortunately little studied. […] But the very extraordinary insight which some persons are able to gain of others from indications so slight that it is difficult to ascertain what they are is certainly rendered more comprehensible by the view here taken.
>
> –Charles Sanders Peirce, 1892[355]

How could he talk about intuitive telepathy along with communication? *Tele-* in Greek signifies "distant" and *-pathy* does "passing" whereas *communicatio* in Latin was the one-word expression for "action from a distance" so they look cognate. This filiation is not aberrant but has appeared elsewhere in the history of communication (e.g. Peirce) to return lately with Asian horror films. Worth mentioning in English are Sir Isaac Newton and John Locke, two 17th-century geniuses. Why the falling apple? Newton would reply: by gravity through a void. Why gravity then? Due to general attraction.[356] Why general attraction? Towards communication which binds matters together. Why communication? As the *deus ex machina* or divine power. Newton was hesitant about giving any decided answer to such a theological inquiry—thus *hypotheses non fingo*; later, Newtonians admitted that it was possible to convey without physical mediation something amongst bodies.

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[355] *Collected Papers* (Cambridge: Harvard University Press, 1931-35 & 1958), Volume VI, paragraphs 159-61 (citation is to *CP* Volume. paragraph).

[356] Which is a mathematical law; see Alexandre Koyré, *Newtonian Studies* (London: Chapman & Hall, 1965).

Attraction meant to Newton what "association" did to Locke (see **2. 2. 2** for their science-philosophy alliance). His famous *Essay Concerning Human Understanding* has more than 30 paragraphs on communication: only those in Book III deal with signification while he discussed communications either of *motion upon impulse* or from God elsewhere, in the same vein with Saint Thomas Aquinas[357] illuminating how angels' voice is transmitted—although interior—to others of a lower hierarchy instantaneously without loss.

Peirce was hardly alone in his curiosity about telepathy, if not animal magnetism: "I know very well that my dog's musical feelings are quite similar to mine though they agitate him more than they do me. He has the same emotions of affection as I, though they are far more moving in his case. You would never persuade me that my horse and I do not sympathize."[358] Peirce's metaphysical friends including American contemporaries were ambushing emergent technologies like *spirit* photography and the discovery of x-rays or Roentgen revolution: Thomas Alva Edison tried visually to pierce the skull and David Starr Jordan to capture thoughts on a "psychic retina," both in vain.

Let me highlight these stories as they may be more than scandals, according to Erkki Huhtamo's media *archaeology*: which is different from collecting underground materials[359] but asking why similar hopes and fears (e.g. democracy, moral panics respectively) arise each time a new medium gets introduced as though people undergo amnesia, whether the history of users' mind—if not of technologies *per se*—is continuous. Without the wide-spread fascination over extrasensory perception, Jordan above could not have validated his pseudo-scientific investigation simply by adopting x-rays' hardware credibility: many post-1896 developments were subject to such tactics of rhetorical integration as into socially recognizing less orthodox findings.[360]

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[357] *Summa Theologiæ* (London: Blackfriars, 1968-75), 1a. 76 & 84-85.

[358] *CP* I. 314.

[359] And it does not entail research at some dusty archives: for this Edison incident, I relied upon the *New York Times* online database.

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[360] Harry M. Collins and Trevor J. Pinch, "The Construction of the Paranormal: Nothing Unscientific is Happening," in *On the Margins of Science: The Social Construction of Rejected Knowledge*, ed. Ray Wallis (Keele: University of Keele, 1979).

6. 2. 1. No-brainer

> Mr. Edison was asked if it were true that he intended to photograph a skeleton head by means of the Röntgen rays. He smiled, as he replied: "Yes; we are making some special long tubes which will give a five-inch distance between the poles in vacuum. Some day next week one of our boys will lay his head down on the table, and we shall suspend a battery of five of these large tubes over his head, so as to get a profile and side-face view. That will be merely to try our set of large tubes in combination." –*New York Times*, February 9, 1896

This newspaper had followed Thomas Alva Edison since one day before the interview when he strove to picture a human *cerebrum*, which the above interviewer considered "very absurd." Still, our Jersey inventor was quoted February 20 saying that "by the last of the week" he should be able to photograph *bones* in a man's cranium. *New York Times* was incorrect to call this successful as, on the 13th, Edison gave up revealing our most innate functions anyway. In believing all stuff allowed Roentgen rays (*NYT*, Feb. 14), the founder of General Electric Company was yet to narrow down their commercial, let alone diagnostic, uses but enthusiastically focused enough radiation to make a technically clearer image.[361]

Ignoring the difference between soft and hard tissue, Edison discovered some "practical" benefit of inspecting the bony structures through hands on March 17, which others had already done (see **6. 1**); during February 1896, *the New York Times* had covered such breakthroughs as the detection of a fractured arm (February 10 at Dartmouth College and 18 in Brooklyn), instantaneous x-ray photos (Feb. 12), the location of a needle hidden in a foot (the 14th, both in Toronto) and of a shotshell[362] between the fingers (13th, in Chicago), three *Medical News* articles on surgical applications reprinted (15th, followed by one upon Edison knowing admittedly nothing about photography). He fell behind this rush of discoveries due to his neurological obsession; Edison might have needed instead nuclear magnetic resonance imaging.

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[361] "If two bulbs give a sharper outline than one," Edison announced to *New York Times* on February 13, 1896, "then four bulbs ought to give an image still sharper, and there is no limit

6. 2. 2. Never-minder

> Prof. Rogers in a matter-of-fact way looked for a few minutes at a postage stamp, then retired to a dark room, and gazed through the lens of the camera at the sensitive plate. The figure of the postage stamp was on his mind, and from his mind it passed out through the sensitive ether to the place made ready to receive it. The result was a photograph of the stamp—small and a little blurred, but showing the undoubted features of the gracious Queen and the words "one penny." Thus was the bridge between psychic power and photographic sensitiveness made once for all. This connection established, there is naturally no limit to the application of the principle.

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to the power we may get or the distance we may make the Roentgen rays traverse." Without this question readily solved, he stopped experimenting on skulls *in vivo*.

[362] Reports on *New York Times* that a Professor Fox in Montreal succeeded as early as February 7, Prof. Bergmann of Germany and Prof. Trowbridge respectively on the 17th are not confirmed elsewhere (see **Chapter 5**).

> It thus becomes plain that the invisible rays of Röntgen are not light in the common sense, but akin rather to the brain emanations, or odic forces, which pass from mind to mind without the intervention of forms of gross matter as a medium, and to which gross matter in all its forms is subject.
>
> Nor is this principle new in the philosophy of man. The wise of all ages have held that mind is sovereign over matter. [...] By psychic intensity the cohesion of molecules of gross matter may be overcome. It is well known to physicists that these molecules nowhere actually touch each other, nor do they come near doing so. The spaces between them are filled up by ether. Into the interstices of the ether it is easy for the odic force to introduce itself. It is, in fact, unlikely that the gross particles of stone exist at all; for, as some physicists have shown, these are but eddies or vortex-rings in the ether itself, which is the only material reality.
>
> Mr. Marvin showed very clearly that this supposed legend was not lightly to be set aside as mythology; or, rather, that it is likely that mythology is the only true history. The same psychic strength and wisdom which have caused Odin to be remembered and revered as a god by our ancestors, was the same psychic force by which he overcame the cohesion of matter.
>
> –David Starr Jordan, "The Sympsychograph," 1896

Within months, the list of Röntgen-inspired hoaxes[363] added yet another eminent member. A notorious claim for x-rayed occultism came when Jordan, then Stanford University's president, released "The Sympsychograph: A Study in Impressionist

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[363] For example, Nancy Knight, "'The New Light': X Rays and Medical Futurism," in *Imagining Tomorrow: History, Technology, and the American Future*, ed. Joseph J. Corn (Cambridge: The MIT Press, 1986).

Physics" in September that year of illusionism.[364] According to his description, Asa Marvin at the Astral Camera Club[365] in Alcalde devised some apparatus with a compound lens that was electrically wired into the eye of each observer with no detail therein as to how. The subject's idea got fixed upon a cat, and the image came out (Figure 6. 2. 2-1). This report, where I cannot tell what Jordan's own participation in the alleged finding was, sounds fraudulent at the point that he promises to capture felines' ultimate[366] impressions of man. The picture turned out to be a faint composite of several photos.[367]

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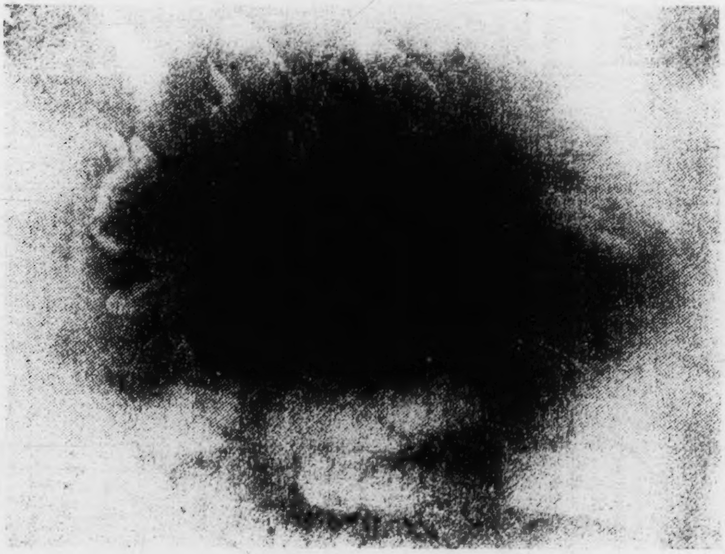
[364] "The Sympsychograph: A Study in Impressionist Physics," *Appleton's Popular Science Monthly* 49 (1896): 597-602.

[365] Presumably inspired from William T. Stead's review in 1891, *Real Ghost Stories* (http://www.gutenberg.org/files/20420/20420-h/20420-h.htm).

[366] Rogers' *ideography* was about securing an individual object while *sympsychography* chased after some essential type in collective minds.

[367] *The Electrical World*, October 3, 1896, 403; citing *New York World* that is compared with *NYT* by Michael Schudson, *Discovering the News: A Social History of American Newspapers* (New York: Basic Books, 1978), 88-120. The sensationalist *World* favoured a focus upon aggressively laid-out headlines and entertainment while the reputation-driven *Times* prioritized socially approved information. These opposite models of journalism continue today.

Figure 6. 2. 2-1. "This picture is unmistakably one of a cat"[368]



6. 2. 2. 1. Spiritist photography and thoughtography

This ghost-like reality is *unredeemed*. It consists of elements in space whose configuration is so far from necessary that one could just as well imagine a different organization of these elements. Those things once clung to us like our skin, and this is how our property still clings to us today. Nothing of these contains us, and the photograph gathers fragments around a nothing. When the grandmother stood in front of the lens, she was present for one second in the spatial continuum that presented itself to the lens. But it was this aspect and not the grandmother that was eternalized. A shudder runs through the view of old photographs. For they make visible not the knowledge of the original but the special configuration of a moment; what appears in the photograph is not the

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[368] Jordan, "The Sympsychograph," 601.

> person but the sum of what can be subtracted from him or her. –Siegfried Kracauer, *Das Ornament der Masse*, 1927[369]

So did he mean that, by taking somebody to light (*photo*), we shall bring the darkness of mortality to her? Certain spirit pictures are taken for harmless fun or to demonstrate how they might fool the audience. In a three-dimensional photo (see Figure 6. 2. 2. 1-1) the guy sitting on a chair seems to have witnessed the indistinct apparition that we can too, naked-eye: hence nothing is added up by Sir David Brewster's technique. He let a woman draped in white attire rush before the wooden table and pose like a phantom—counting *one Mississippi, two Mississippi*—only to vanish shortly while the actor never moved—*one hundred Mississippi, one hundred and one Mississippi*—looking scared during a long exposure as required in the mid-19th century.[370]

Others however debated spectres' genuineness seriously. William Henry Mumler was prosecuted for duping the innocent[371] but soon exonerated because of insufficient evidence against him: doubters could identify no trickery in his studio re-enactment. There was another inflation of such controversies right before Wilhelm Conrad Röntgen's news hit British people (see **6. 1**): Sir William F. Barrett in 1895 submitted pictures of Lord Combermere hanging around; he accidentally had died and was being coincidentally buried, to his Society for Psychical Research colleagues.[372] James Coates assembled 20th-century illustrations of spooky imagery, e.g. Edward Wyllie's portrait of a fellow Robert Whiteford along with another face that, unlike Brewster's actress, nobody on-site was said unable to notice.[373] I should therefore locate David Starr Jordan's *sympsychography* between these episodes—chronologically.

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[369] *The Mass Ornament: Weimar Essays* (Cambridge: Harvard University Press, 1995), 56-57.

[370] Frank R. Fraprie and Walter E. Woodbury, *Photographic Amusements: Including Tricks and Unusual or Novel Effects Obtainable with the Camera* (New York: Arno Press, 1973), 5-10.

[371] *Harper's Weekly*, May 8, 1869.

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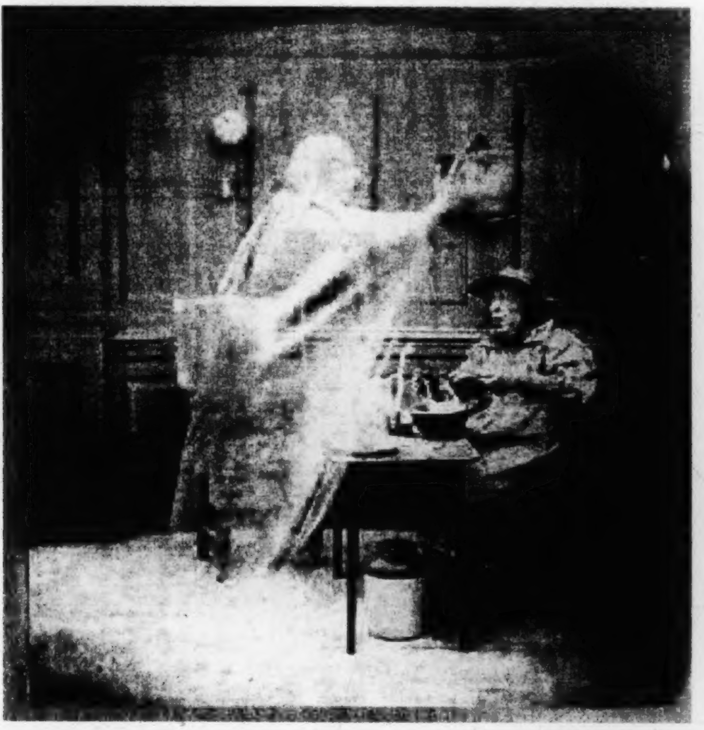
[372] Jennifer Tucker, "Photography as Witness, Detective, and Impostor: Visual Representation in Victorian Science," in *Victorian Science in Context*, ed. Bernard Lightman (Chicago: The University of Chicago Press, 1997), 395-402; W. F. Barrett, *On the Threshold of the Unseen: An Examination of the Phenomena of Spiritualism and of the Evidence for Survival after Death* (London: Kegan Paul, Trench, Trubner & Co., 1917), 88-92.

[373] J. Coates, *Photographing the Invisible: Practical Studies in Spirit Photography, Spirit Portraiture, and Other Rare but Allied Phenomena* (New York: Arno Press, 1973), 244.

Figure 6. 2. 2. 1-1. "Ghost in the stereoscope" by the London Stereoscopic Company[374]



Ideography or an inscription (see **Chapter 2**) produced upon the sensitive plate by externalizing ample mental energy of memories without any physical connection[375] was re-launched decades later.[376] In direct reference to x-rays, Sir William Crookes fostered a major stir in the early half of 1870s by openly championing such leading mediums as Daniel Dunglas Home but other cranks too. After decades, back into reputable chemistry—e.g. invention of the high-vacuum cathode tube where radiation's mechanical pressure is detectable—his appeal went again:

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[374] Wm. B. Becker Collection/American Museum of Photography; see also D. Brewster, *The Stereoscope: Its History, Theory, and Construction* (Hastings-on-Hudson: Morgan & Morgan, 1971), 205-6.

[375] Which he attributed to I. Rogers; see D. S. Jordan, "The Sympsychograph: A Study in Impressionist Physics," *Appleton's Popular Science Monthly* 49 (1896): 597-602.

> Röntgen has familiarised us with an order of vibrations of extreme minuteness compared with the smallest waves with which we have hitherto been acquainted, and of dimensions comparable with the distances between the centres of the atoms of which the material universe is built up; and there is no reason to suppose that we have here reached the limit of frequency. It is known that the action of thought is accompanied by certain molecular movements in the brain, and here we have physical vibrations capable from their extreme minuteness of acting direct on individual molecules, while their rapidity approaches that of the internal and external movements of the atoms themselves.
>
> Confirmation of telepathic phenomena is afforded by many converging experiments, and by many spontaneous occurrences only thus intelligible. The most varied proof, perhaps, is drawn from analysis of the sub-conscious workings of the mind, when these, whether by accident or design, are brought into conscious survey. […] To mention a few names out of many, the observations of Richet, Pierre Janet and Binet (in France), or Breuer and Freud (in Austria), of William James (in America) have strikingly illustrated the extent to which patient

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[376] Jule Eisenbud, *The World of Ted Serios: "Thoughtographic" Studies of an Extraordinary Mind* (New York: William Morrow & Company, 1967); Cyril Permutt, *Beyond the Spectrum: A Survey of Supernatural Photography* (Cambridge: Patrick Stephens, 1983), 88-113.

> experimentation can probe sub-liminal processes, and thus can learn the lessons of alternating personalities and abnormal states.[377]

French effluvists such as Hippolyte Baraduc, Albert de Rochas and Louis Darget appropriated the "radiograph" vocabulary for their endeavours to picture whatever comes from the vital body while roentgenology depended on some artificial source of radiation. Yet the public did not care, hoping that x-rays would provide a link to any unknown realm.[378] How do we theoretically explain this wishful credulity which remained consistent across different technologies?

6. 2. 2. 2. Media archaeology

> Do not seek the old in the new, but find something new in the old. If we are lucky and find it, we shall have to say goodbye to much that is familiar in a variety of respects. –Siegfried Zielinski[379]

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[377] W. Crookes, *Researches in the Phenomena of Spiritualism* (Manchester: Two Worlds Publishing Company, 1926), 131-32; Sir Arthur Conan Doyle, a bereaved father, contributed thereto in *The History of Spiritualism* (New York: Arno Press, 1975). See also Janet Oppenheim, *The Other World: Spiritualism and Psychical Research in England, 1850-1914* (Cambridge: Cambridge University Press, 1985), 349-50.

[378] Clément Chéroux, "Photographs of Fluids: An Alphabet of Invisible Rays," in *The Perfect Medium: Photography and the Occult* (New Haven: Yale University Press, 2005).

[379] *Deep Time of the Media: Toward an Archaeology of Hearing and Seeing by Technical Means* (Cambridge: The MIT Press, 2006), 3.

Friedrich A. Kittler's problematic reliance upon Michel Foucault[380] helped give birth to "Medienarchäologie" à la Foucault's *Archaeology of Knowledge*; unless in German, neither Zielinski nor Kittler has been rendered easy to verbatim understand. When translating Zielinski's *Archäologie der Medien: Zur Tiefenzeit des technischen Hören und Sehen* quoted above, Gloria Custance replaces "archaeology" with "deep time" (*Tiefenzeit*) from the subtitle.[381] This is unfortunate as readers would easily be lead into other media-archaeological stuff: e.g. "Media Archaeology" the ctheory.net[382] essay by Zielinski that has appeared on-line for a decade. Custance also rephrased *Audiovisionen: Kino und Fernsehen als Zwischenspiele in der Geschichte* into *Audiovisions: Cinema and Television as Entr'actes in History* several years ago; "interludes" or "intermissions," even "intermezzi" the Italian plural may look more comprehensible to Anglophones than "entr'actes" which denotes "Zwischenspiele" literally. Could she not have ended with "Audiovisions" nor indicated between (*entre*, *zwischen*) what our author located both cinema and television historically? I suspect they are hardly between two sections of an operatic play. Also, why "Hören und Sehen" differs from "Audiovision" is beyond me.

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[380] For which David E. Wellbery's foreword to *Discourse Networks 1800/1900* is more quotable than its main composition by Kittler: see **2. 1. 2. 3**; *Aufschreibesysteme* fell into *Discourse Networks* yet emphatically by "auf-schreiben" instead of "schreiben" he was à la Bruno Latour approaching the notion of writing-down upon some two-dimensional matter, and "Systeme" rather than "Netzwerk" hints Niklas Luhmann's influence on German media studies, whose founding father was Gottfried W. F. von Leibniz on the communication of substances. Let me quote the afterword translated by Michael Metteer with Kittler's original expressions bracketed: "The term *discourse network* [Aufschreibesystem], as God revealed it to the paranoid cognition of Senate President Schreber, can also designate the network [Netzwerk] of technologies and institutions that allow a given culture to select, store, and process relevant data. Technologies like that of book printing and the institutions coupled to it, such as literature and the university, thus constituted a historically very powerful formation, which in the Europe of the age of Goethe became the condition of possibility for literary criticism. In order to describe such systems [Systeme] as systems [Systeme], that is, to describe them from the outside and not merely from a position of interpretive immanence, Foucault developed discourse analysis [Diskursanalyse] as a reconstruction of the rules by which the actual discourses [Diskurse] of an epoch would have to have been organized in order not to be excluded as was, for example, insanity." Kittler, *Discourse Networks 1800/1900* (Stanford: Stanford University Press, 1990), 369.

[381] It must go less deep than James Hutton, a palaeontologist, believed our Planet Earth to be: *Time's Arrow, Time's Cycle* i.e. a volume by Stephen Jay Gould regarding Hutton got renamed *Die Entdeckung der "Tiefenzeit"* in German though.

This prefigures Erkki Huhtamo's proposal to undertake "first, the study of the cyclically recurring elements and motives underlying and guiding the development of media culture; second, the 'excavation' of the ways in which these discursive traditions and formulations have been 'imprinted' on specific media machines and systems in different historical contexts, contributing to their identity in terms of socially and ideologically specific webs of signification."[383] This clarity makes Huhtamo's work a kinder entry point: Zielinski dispenses with recent examples while Huhtamo with real instruments but *discursive* ones rather. His examples of domestic entertainment

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[382] Another related Canada-led input to archaeology is Charles R. Acland, ed., *Residual Media* (Minneapolis: University of Minnesota Press, 2007).

[383] E. Huhtamo, "From Kaleidoscomaniac to Cybernerd: Notes toward an Archeology of Media," in *Electronic Culture: Technology and Visual Representation*, ed. Timothy Druckrey (New York: Aperture, 1996), 303.

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(stereoscopy, fantasmagorie,[384] telectroscopy) are comparable with Paul Valéry's futuristic world originally dated 1928 which soon turned out actual in radio-like things:

> Just as water, gas, and electricity are brought into our houses from far off to satisfy our needs in response to a minimal effort, so we shall be supplied with visual or auditory images, which will appear and disappear at a simple movement of the hand, hardly more than a sign. […] I do not know whether a philosopher has ever dreamed of a company engaged in the home delivery of Sensory Reality. Of all the arts, music is nearest to this transposition into the modern mode. Its very nature and the place it occupies in our world mark it as the first to be transformed in its methods of transmission, reproduction, and even production. It is of all the arts the most in demand, the most involved in social existence, the closest to life, whose organic functioning it animates, accompanies, or imitates.[385]

Admitting that Valéry was a big name,[386] Zielinski has laboriously visited libraries in Hungary, Russia, Latvia, Czecho-Slovakia, Poland, Ukraine, Italy, Austria etc. to discover that Giuseppe Mazzolari a.k.a. Josephus Marianus Parthenius attempted in the

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[384] Oliver Grau situates this between 17th-century *laterna magica* and Zoe Beloff et al.'s image works: all endeavouring "to communicate with the dead." Grau, *MediaArtHistories* (Cambridge: The MIT Press, 2007), 137-61.

[385] P. Valéry, "La Conquête de l'ubiquité," in *Œuvres, v. II* (Paris: Librairie Gallimard, 1960), 1284-85; translated in *Aesthetics* (New York: Pantheon Books, 1964), 226.

[386] Cited in Régis Debray, *Vie et mort de l'image: Une Histoire de regard en Occident* (Paris: Éditions Gallimard, 1992); media archaeologists should contextualize Valéry as versatile beyond his petit-bourgeois class: see Jean-Paul Sartre, *Critique de la raison dialectique, t. I—Théorie des ensembles pratiques* (Paris: Gallimard, 1960), 43-47.

18th century to "establish a method of speaking" over distances.[387] Not only Democritus/Epicurus/Lucretius, whom Michel Serres brings to current philosophy,[388] but Empedocles take a chapter since their perception theories "have some bearing upon the frenetic contemporary sphere of activity."[389] We discover new media interfaces buried in Empedocles' old yet never obsolete documents; there should be no use digging out *vice versa*, as prominent historiographers do, something Empedoclean and destined to constant progress within certain typical cutting-edge inventions.[390] For the case of a rather popular and communicative (i.e. telepathic) expectation, I appreciate Tom Gunning's—yet another media archaeologist introduced by Huhtamo—discussion of William H. Mumler, Edward Wyllie et al.'s arguments.[391] Neither they nor David Starr Jordan of sympsychography helped to mold diagnosis. However, the idea of depicting everyday media as tools for a séance—or as mediums—has emerged again in Japanese and mostly Hollywood-remade movies like *Cure* (phonograph record),[392] *Ring* (video tape), *Pulse* (internet), *Dark Water* (instant picture) and *One Missed Call* (mobile phone). Medicine is about outside looking in; mysticism, this world looking beyond.

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[387] S. Zielinski, *Deep Time of the Media*, 162.

[388] M. Serres, *The Birth of Physics* (Manchester: Clinamen Press, 2000).

[389] Zielinski, *Deep Time of the Media*, 53.

[390] Lisa Gitelman, a Thomas Alva Edison scholar, has been quiet about his failed x-ray experiments and keeps her non-choice as such from Kittler and media archaeology which, she misunderstands, refuses narratives but takes a past tool only to glorify the present in comparison; see *Always Already New: Media, History, and the Data of Culture* (Cambridge: The MIT Press, 2006).

[391] T. Gunning, "Phantom Images and Modern Manifestations: Spirit Photography, Magic Theater, Trick Films, and Photography's Uncanny," in *Fugitive Images: From Photography to Video*, ed. Patrice Petro (Bloomington: Indiana University Press, 1995).

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[392] When saying, "Part of the X ray's power rested in its ability to 'speak for itself,' to offer a representation of the inner body apart from its referent in time and space, thus opening it up for intersubjective perception. In that respect, Röntgen's device resembles a contemporary technological invention: the gramophone," José van Dijck cited Kittler whose stoic two-dimensional inscription theory seems favoured than Bruno Latour's; van Dijck, *The Transparent Body: A Cultural Analysis of Medical Imaging* (Seattle: University of Washington Press, 2005), 88. Is this Dutch researcher's perspective on diagnostic instruments shifting from science studies to media archaeology? Unlikely—because, for instance, not the materiality of *Fantastic Voyage* (either a Richard Fleischer movie or Otto Klement and Jay Lewis Bixby's novel) but its contents matter to her which report endoscopic desires around 1966.

7 … then plural *iconicity*

Taking advantage of Wilhelm Conrad Röntgen's discovery, *computed tomography* came in the late 1960s to replace those radiological tests which were frequently uncomfortable and hard to decipher. Its mathematical back-projection technique was soon exploited by *nuclear magnetic resonance imaging* that, like still laboratory-driven *positron emission tomography*, is based upon a method to represent the chemistry of soft-tissue molecules. This chapter shall compare them,[393] which is summarized as below.

Table 7-1. High-cost noninvasive nuclear medicine[394]

	C(A)T	(N)MR(I)	PET
source	x-rays	magnetic fields	radioactive isotopes
targets	blood clots; fractured skeleton; operating/emergency room; brain tumours	brain diseases/tumours; pituitary tumours; multiple sclerosis/myelin deterioration; knees	epilepsy/seizure disorders; malignancies; cancer; Alzheimer's; brain-mapping
merits	speed; scans bones and cartilage	inside bony structures (e.g. joints)	assesses metabolism; real-time
drawbacks	limited application and tissue definition; ionizing radiation	does not image bone; slow (except in experimental modes)	research-oriented; low spatial granularity; complex

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[393] I have chosen not to detail functional-MRI, single photon emission tomography etc.

[394] Bettyann Holtzmann Kevles, *Naked to the Bone: Medical Imaging in the Twentieth Century* (Reading: Addison-Wesley, 1997), 225.

7. 1. Computer-assisted tomography

7. 1. 1. *La sémiotique des samouraïs*[395]

Intended or not, when Julia Kristeva named her debut novel after—while the cast therein depicting Parisian structuralists around '68 were identified with—some East Asian swordsmen i.e. *Les Samouraïs*, it also reminds me of Timaeus discussing with Socrates et al. how to sculpt a somatic *chora* that is vague.[396] Louis Hjelmslev quotes Ferdinand de Saussure in French who, earlier and more Platonic than Kristeva, already concerned himself with this:

> Prise en elle-même, la pensée est comme une nébuleuse où rien n'est nécessairement délimité. Il n'y a pas d'idées préétablies, et rien n'est distinct avant l'apparition de la langue. … La substance phonique n'est pas plus fixe ni plus rigide; ce n'est pas un moule dont la pensée doive nécessairement épouser les formes, mais une matière plastique qui se divise à son tour en parties distinctes pour fournir les signifiants dont la pensée a besoin. Nous pouvons donc représenter … la langue … comme une série de subdivisions contiguës dessinées à la fois sur le plan indéfini des idées confuses … et sur celui non moins

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[395] Yun-Csang Ghimn, "Visual and Linguistic Communication in the History of Medicine-From Semiotics in Medicine to Semiotics of Pain," *Visio* 8 (2003): 280-82; see **2. 2. 6 & 7**.

[396] J. Kristeva, *Revolution in Poetic Language* (New York: Columbia University Press, 1984).

> indéterminé des sons … la langue élabore ses unités en se constituant entre deux masses amorphes … *cette combinaison produit une forme, non une substance.*[397]

Based upon Hjelmslev's glossary, *analysis* helps recognize a complex system consisting of categories behind or below whatever is jumbled but reachable by the senses. It undertakes a division thereof and continues exhaustively until one cannot further chop up such ultimate components: from the chained text into—via sentence, clause, word—e.g. semantically feminine/masculine (*elle* > *il*-même) and voiceless/-d sounds phonetically (*c*- > *g*omme). Also in his last decade, Algirdas Julien Greimas—a Helmslevian—tried bringing this Saussurian assignment, if not obsession, back to what Timaeus' physi(ologi)cal lecture was about: i.e. like the samurai but just analogically (i.e. these academics mostly go without drawing real blood invasively), articulating or partitioning off something *corporeal.*[398] Hence, though Christian Metz—a visual semiotician—described photography cutting fragments inside the object,[399] I believe this is much truer of tomographies (*τομ-* e.g. in dichotomy) as we shall find about its mechanism soon.

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[397] F. de Saussure in L. Hjelmslev, *Prolegomena to a Theory of Language* (Madison: The University of Wisconsin Press, 1961), 49-50.

[398] Anne Hénault, *Histoire de la sémiotique* (Paris: Presses Universitaires de France, 1992), 116-19.

[399] C. Metz, "Photography and Fetish," in *OverExposed: Essays on Contemporary Photography*, ed. Carol Squiers (New York: New Press, 1999).

7. 1. 2. CAT jumped in, cross-sectionally

> It was deduced that measurements of x-ray transmission, taken from all possible directions through a body, would contain all the information on the internal structure of that body. It was appreciated that the results would be very difficult to interpret. –Godfrey Newbold Hounsfield[400]

Electric & Musical Industries, Limited[401] was into pattern recognition—a task for hired engineers like Hounsfield and the firm itself whose major concern had included playing back what a human operator helps record: studies to automate this step had already started. The data could be not only stored in a computer at EMI Ltd. while the equipment circles its object, but also processed to extract whatever is found relevant. For illustration, a 2 * 2 matrix yields 6 sums—horizontally, diagonally and vertically. Numbers *guestimated* originally from each row (equal division presumed: 12/2=6, 8/2=4) are checked subsequently against readings compiled down via the columns (9 < 6+4 < 11; Figure 7. 1. 2-3) so those obvious discrepancies get adjusted.[402]

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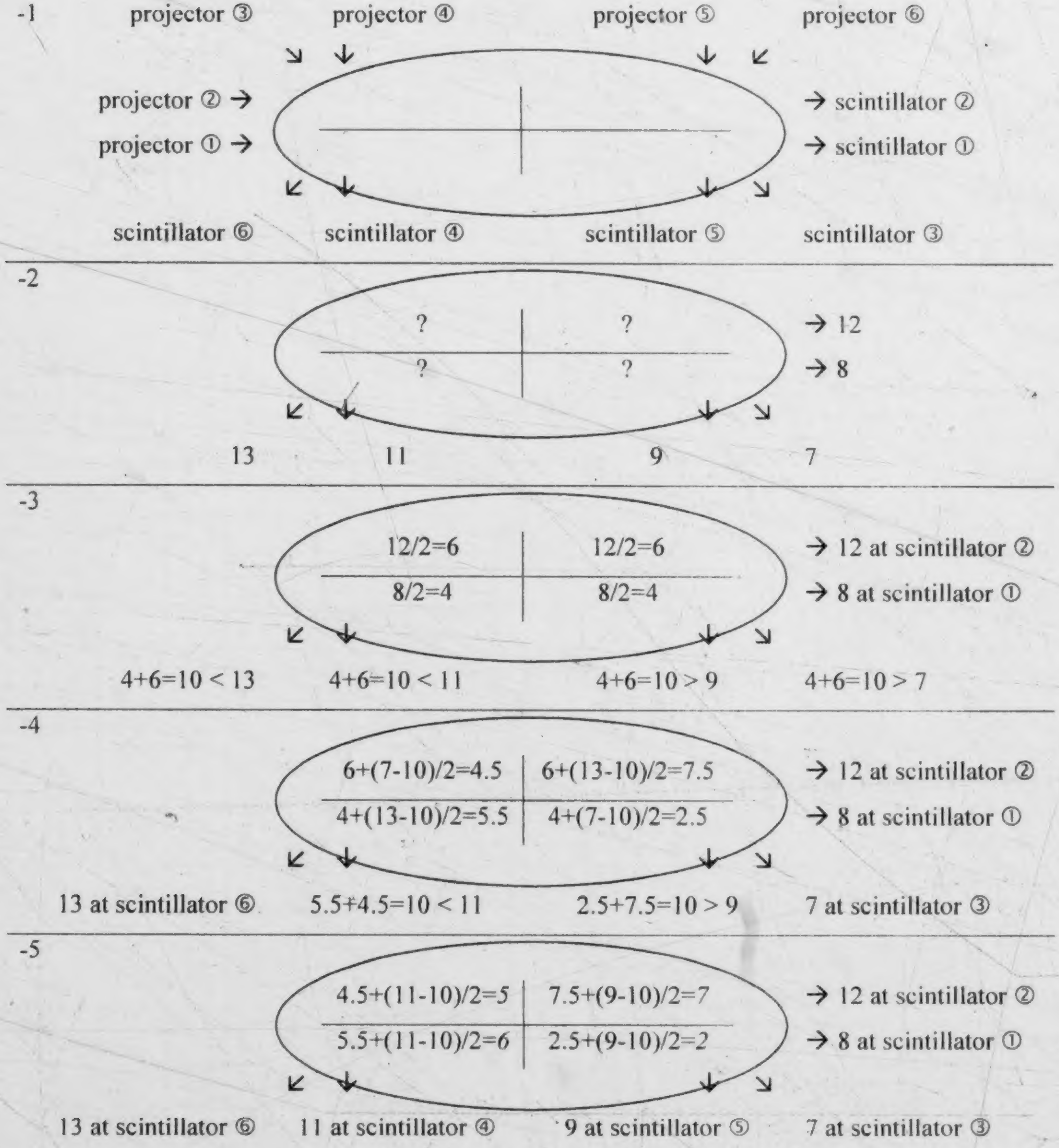
[400] "Historical Notes on Computerized Axial Tomography," *Journal of the Canadian Association of Radiologists* 27 (1976): 135-42.

[401] The syndicate of Marconiphone, Columbia's branch in Britain and *Gramophone*—after Thomas Alva Edison's invention (see **7. 3. 2. 2**)—Company.

[402] Charles Sanders Peirce suggests, "we may look through the known facts and scrutinize them carefully to see how far they agree with the hypothesis and how far they call for modifications of it." *Collected Papers* (Cambridge: Harvard University Press, 1931-35 & 1958), Volume VII, paragraph 114.

Figure 7. 1. 2-1~5. CT formula simplified[403]



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[403] Leslie M. Zatz, "Basic Principles of Computed Tomography Scanning," in *Radiology of the Skull and Brain; v. 5—Technical Aspects of Computed Tomography*, eds. Thomas H. Newton and D. Gordon Potts (St. Louis: The C. V. Mosby Company, 1981), 3857.

Hounsfield realized a possible adaptability of such puzzle-solving to roentgenology where, traditionally, blurry shadows of mass standing before or after each other (e.g. rib, lung, vertebra with various densities from solid to cystic) are superimposed. EMI's own Central Research Laboratories thus collaborated with the National Health Service from 1968 on,[404] which lacked no expertise in developing medical stuff. Having gathered sufficient data to scan a selected corporeal slice (*τομος*) by passing radiographic beams at each slant rotating around it, rather than plunging any knife (*τομευς*), those members could employ sudoku-like tactics necessary for electronic construction of the image that looks similar to a cut plane. Transverse anatomy is now observed with little hazard to patients.

Its wide availability has changed the diagnostic approach; when hospitals considered purchasing such a sophisticated modality, both the device (Figure 7. 1. 2-6) and usage were substantially new to most staff. Physicians had better specialty in visual semeiotics or (theoretical) diagnostics to often make decisions quickly,[405] yet mechanics would pick up their more practical hands-on knowledge of apparatus itself to routinely negotiate a new division of labour with those doctors at hospital.[406]

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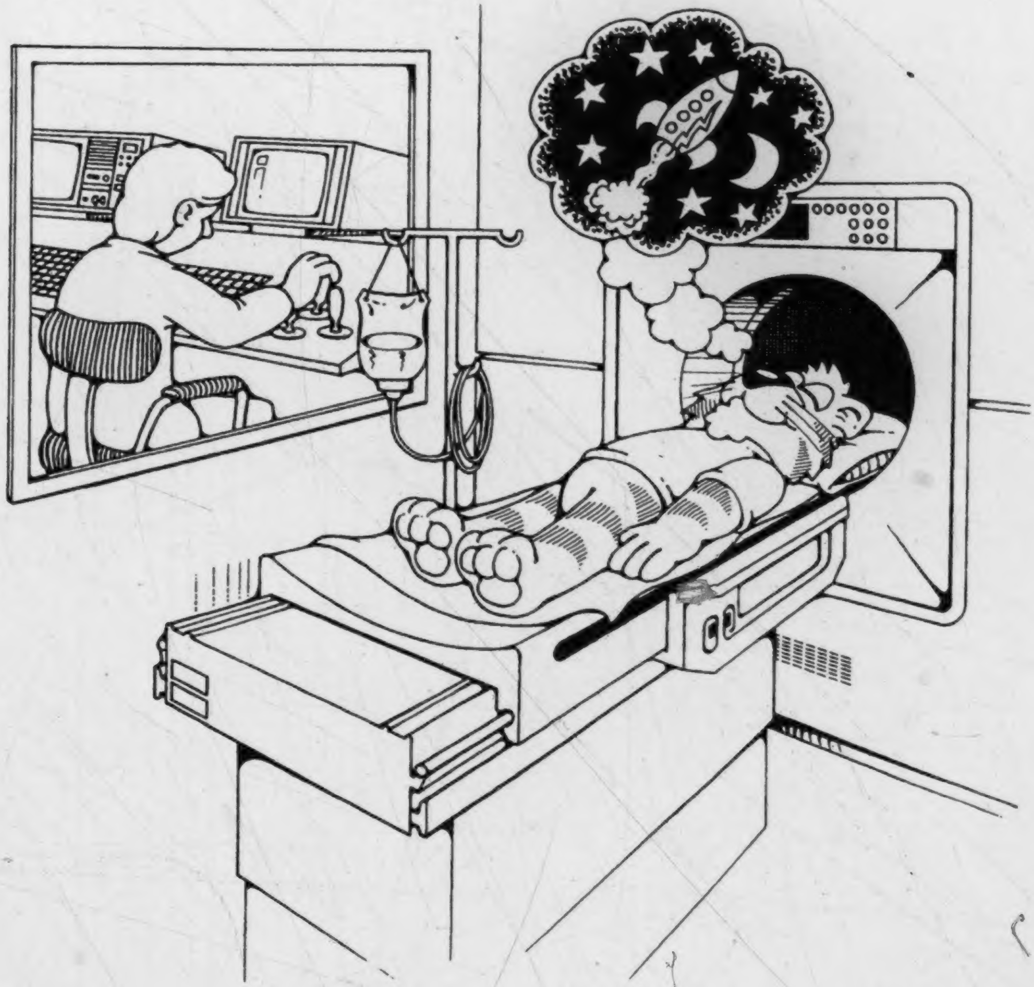
[404] G. R. Higson, "The Beginning of CT Scanning—A Personal Recollection," *Bulletin of the British Institute of Radiology* 5 (1979): 3-4.

[405] For the Hippocratic aphorism, see **2. 2. 1**.

[406] Stephen R. Barley, "Technology as an Occasion for Structuring: Evidence from Observations of CT Scanners and the Social Order of Radiology Departments," *Administrative Science Quarterly* 31 (1986): 78-108; see **7. 3. 2** for Greimassian organizational, actant-in-science studies.

Figure 7. 1. 2-6. Cat in a CAT scanner[407]



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[407] Kathleen Ashton Vrabel and Galterius Grajo, *"X-Ray! X-Ray! Read All about It!" CAT Scan: Number One Member of the Get Well Team* (Youngstown: Ped Pals, 1989); illustration by Jim Young, © YHA, Inc (defunct).

7. 2. Nuclear magnetic resonance imaging

7. 2. 1. Iconology revisited (1)

> It is impossible to find a proposition so simple as not to have reference to two signs. Take, for instance, "it rains." Here the icon is the mental composite photograph of all the rainy days the thinker has experienced. The index, is all whereby he distinguishes *that day*, as it is placed in his experience. [...] As the index may be complex, so also may the icon. For instance, taking the universal selective index, *everything*, we may have an icon which is composed alternatively of two, a sort of composite of two icons, in the same way that any image is a "composite photograph" of innumerable particulars. Even what is called an "instantaneous photograph," taken with a camera, is a composite of the effects of intervals of exposure more numerous by far than the sands of the sea. Take an absolute instant during the exposure and the composite represents *this* among other conditions. Now, the two alternative icons are combined like that. We have an icon of this alternation, a composite of all the alternative cases we have thought of. –Charles Sanders Peirce[408]

The previous two chapters have been more concerned with physically contiguous *indexicality*,[409] caused by photons once entering into contact with—then soon vanishing but leaving some imprint on—the surface, where *icons* and (to a lesser degree in medicine) conventional *symbols* must also co-exist. Yet, *iconicity* resists it last:

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[408] *Collected Papers* (Cambridge: Harvard University Press, 1931-35 & 1958), Volume II, paragraph 438-41 (citation is to *CP* Volume. paragraph).

[409] Not including **5. 2** apropos hand-retouched photography.

particularly because understanding the abrasion of film is seldom requisite for a diagnostician to assess scans, which falls into engineers' domain.

I shall make no claim on any complete *icons* even indistinguishable from what is resembled: if ever, they appear exclusively in conception. To apply Charles Sanders Peirce's work, x-rays skeletonize the body while electro-/phonocardiographs (see **8. 2. 1**) or mediaeval post-mortem sketches *diagrammatize* it.[410] Charles Morris, poorly annotating Peircianism, considered *iconicity* as simply "how (much) similar" i.e. a question of extent,[411] but radiological techniques cannot be graded in this way. Instead, signs focus upon certain "ground" over the rest via their object: as though, when one touches a *heated* light bulb, features like its *ball curvature* become inconsequential non-factors she or he will hardly consider at the very moment.[412]

Computer-assisted tomography picks up a sufferer's bones from every possible component there; nuclear magnetic resonance imaging exhibits mainly the soft core.[413] Thus, her or his other predicates—deemed less pathological—would go un-imitated. Ensuing and improved from CT in detailed resolution, NMR or MRI neither dominates nor has replaced it owing to Peirce's rather partial *iconicity*: "we cannot comprehend an agreement of two things, except as an agreement in some *respect* [...] Such a pure abstraction, reference to which constitutes a *quality* or general attribute, may be termed a *ground*."[414]

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[410] *CP* III. 559.

[411] C. Morris, *Writings on the General Theory of Signs* (The Hague: Mouton, 1971), 271-73.

[412] *CP* II. 418; what if she or he, a painter, depicts it *yellow*? Ground not only lies within the referent (e.g. size: consistent through comparison) but also is determined by its *representamen* (hue: felt subjectively).

[413] Failing to demonstrate the cerebrum, Thomas Edison should have needed this (see **6. 2**).

Alan G. Gross, also employing Peircian semiotic vocabulary for visual rhetoric so as to supplement ambiguous text, regards post-mortem lithography of 1878 and technically revolutionary NMR scanning with no scalpel to be both distinctively *iconic*. Representing the procured human viscera actually *in situ*; a remarkable difference is that, by means of *functional*-MRI (like positron emission tomography rather; see **7. 3**) five quarter centuries later, doctors could now look through the brain, for example, at its underlying dynamics.[415]

7. 2. 2. Two abbreviations

> Nuclear medical practices provide a reliable and non-intrusive way to diagnose and treat various diseases. Radioisotopes, such as cobalt, xenon, molybdenum and technetium, play an essential role in nuclear medicine. Their many applications include radioactive tracing that helps reveal how living organs function, nuclear

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[414] *CP* I. 551; David Savan's example is a roadside arrow. Only the shape and direction it points at would matter to a traveler while other physical aspects such as the material (wood, metal or plastic), height (ten or twelve feet above street level) and colour (white/black, green/yellow) are less relevant to its function: see D. Savan, *An Introduction to C. S. Peirce's Full System of Semeiotic* (Toronto: Toronto Semiotic Circle, 1987-88), 17-19.

[415] A. Gross, "The Brains in *Brain*: The Co-evolution of Localization and Its Images," *Journal of the History of the Neurosciences* (special issue on visual images and visualization; forthcoming).

> magnetic resonance, which helps collect information about a body's biochemistry, as well as palliative and curative cancer treatment. These techniques allow for early detection, diagnosis, monitoring and treatment of medical conditions and diseases. Canada is a world leader in the production and supply of radioisotopes for medical applications. About 15 to 20 million people [a year], or roughly 67,000 per day, benefit from radioisotopes. Most of the world's medical isotopes are produced in AECL [Atomic Energy of Canada Limited]'s National Research Universal (NRU) reactor at its Chalk River Laboratories.[416]
>
> The Canadian Nuclear Safety Commission (CNSC) has the mandate to ensure the safety of Canadians and the environment by providing regulatory oversight of the nuclear industry. [...] AECL's licence was renewed in August 2006 to operate an upgraded reactor. In November 2007, CNSC staff discovered that the NRU reactor facility status was not in compliance with CNSC licence conditions. Following AECL's planned maintenance shutdown, AECL announced its decision to extend the shutdown of the NRU reactor to complete upgrades as required under the conditions of its licence.[417]

NMR relies upon the *nuclear* characteristic of atoms with unpaired protons (or neutrons) which, placed in a strong *magnetic* field under 0.5~4 Tesla, spin and line up like compass needles. Some appropriate radio-wave energizes the particles (Figure 7. 2. 2-1) and, when turning back to normal i.e. equilibrium, such *resonance* emanates signals with identifiable spectral distribution, rich in content.

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[416] http://www.aecl.ca/Commercial/DIF/Medical/MA.htm

[417] http://www.nuclearsafety.gc.ca/eng/newsroom/releases/ (2007, Dec 6)

MRI appliance utilizes hydrogen—a constituent of water and fats especially abundant within soft tissues.[418] Parallel to each *magnetic* gradient, the signals generated from *resonance* are detected in a large, noisy and tube-shaped machine with its both ends open—similar to one used for x-ray computerized axial tomography (see **7. 1**). So is the *imaging* scheme: obtaining such aligned density of malignant cells by projection from many orientations for long time on the same two-dimensional plane.[419]

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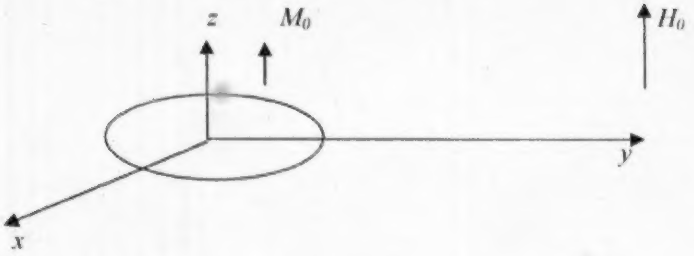
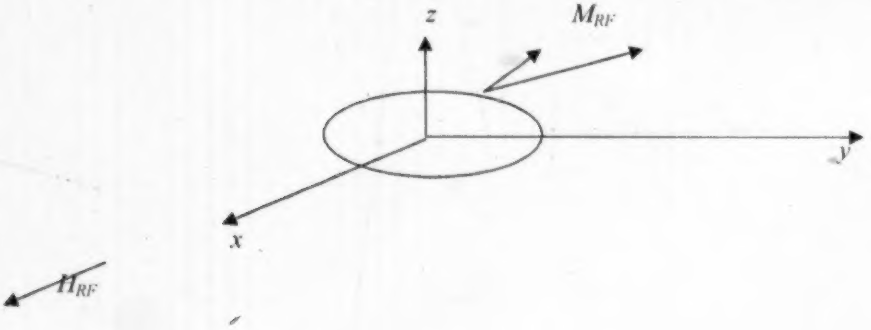
[418] R. Damadian, "Tumor Detection by Nuclear Magnetic Resonance," *Science* 171 (1971): 1151-53.

[419] Paul C. Lauterbur, "Image Formation by Induced Local Interactions: Examples Employing Nuclear Magnetic Resonance," *Nature* 242 (1973): 190-91; for the priority dispute between him and Damadian, see P. Mansfield and P. G. Morris, *NMR Imaging in Biomedicine: Supplement 2. Advances in Magnetic Resonance* (New York: Academic Press, 1982), 5-6. Patients do not understand this scientific innovation though; what they go into at the hospital is a new *machine*. Takahiro Ueyama and Christophe Lécuyer, "Building Science-based Medicine at Stanford: Henry Kaplan and the Medical Linear Accelerator, 1948-1975," in *Devices and Designs: Medical Technologies in Historical Perspective*, eds. Carsten Timmermann and Julie Anderson (Basingstoke: Palgrave Macmillan, 2006).

Figure 7. 2. 2-1. Energy released in NMR[420]



Magnetization as which each vector is summed by a field line (H)
gets away from the z axis with a radio frequency on



Nuclear magnetic resonance imaging therefore is a painless way to clinically scan organs inside the body (e.g. brain, vertebrae, joints). Exposed to no ionizing radiation, patients are not done any known harm unless they carry such metal stuff as pacemakers, are pregnant or have a history of heart surgery. *N*MR the acronym was, in Lisa Cartwright's wildest dream, superseded by MR*I* to hide its being a kind of *nuclear* medicine.[421] Physicists still call the principle of magnetic resonance per se NMR, whose *imaging* offshoot is MRI, with no such conspiracy. Researchers perform nuclear magnetic resonance non-imaging examinations while testing blood or excreta that might reveal certain illnesses: merely derivative biological samples, not a whole sick person, are required.

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[420] William Bradley and Heather Tosteson, "Basic Physics of NMR," in *Nuclear Magnetic Resonance Imaging in Medicine*, eds. Leon Kaufman et al. (New York: Igaku-Shoin, 1982).

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[421] L. Cartwright, "'Experiments of Destruction': Cinematic Inscriptions of Physiology," *Representations* 40 (1992): 129-52.

7. 3. Positron emission tomography

7. 3. 1. PET, another species

> It is unquestionable today that CT and MRI are clinically much more important tools than PET, perhaps with the exception of some specific cases in which PET provides information totally unavailable by CT or MRI. […] PET provides the ability to measure, in vivo, regionally, and noninvasively, a large number of physiological variables that are essential to normal organ functions because pathology derives from or affects normal physiological activities. At this time it appears that PET will contribute to clinical medicine through a better understanding of pathophysiology, and in some applications it will be used directly as a clinical diagnostic tool. –Michel M. Ter-Pogossian[422]

15 years later, PET stays between neuro-scientific research discovering what part of the brain is active during everyday tasks and pathological adaptation showing how diseases like Parkinson's and epilepsy change such areas; or vice versa, giving a psychological syndrome (e.g. Attention Deficit Hyperactivity Disorder) some nosographic entity at the molecular level rather than only being indicated by its symptoms (see **3. 1. 1**). Two different technologies in PET are merged: first, obtaining and manipulating tracers safe enough to be swallowed, inhaled or injected; secondly, building instruments to retrieve signals from those internal markers into bodily maps.

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[422] "The Origins of Positron Emission Tomography," *Seminars in Nuclear Medicine* 22 (1992): 148.

Trans-axial imaging modalities since computer-assisted tomography (see **7. 1. 2**) have visualized a live patient's cross sections. The data from projections at various angles undergo reconstruction through mathematical equations: i.e. each one-dimensional array summarizes unknown values along that line, and they are solved on the grid (Figure 7. 3. 1-1; circuits ① ② in the third row, ③'⑥ in the fourth and ④ ⑤ last) resulting in a grey-scale display. However, the source is neither x-rays nor magnetic fields (MRI) any longer but radiopharmaceuticals which yield positrons with a plus charge; they combine with electrons and such mass (511 keV * 2) is transformed into energy sent out 180 degrees to one another.[423] PET employs this unique form of beta decay by recording gamma-ray photons only, monitored on both sides coincidentally ($< 10^{-8}$ sec) that have the highest probability of being emitted from a region in between. The determination of unstable disease-specific[424] isotopes which are thus accumulated—$^{15}O_2$ for water, to live 2 hours; FDG in 2 days etc.[425]—permits us to numerically track living faculties and plasticity.[426]

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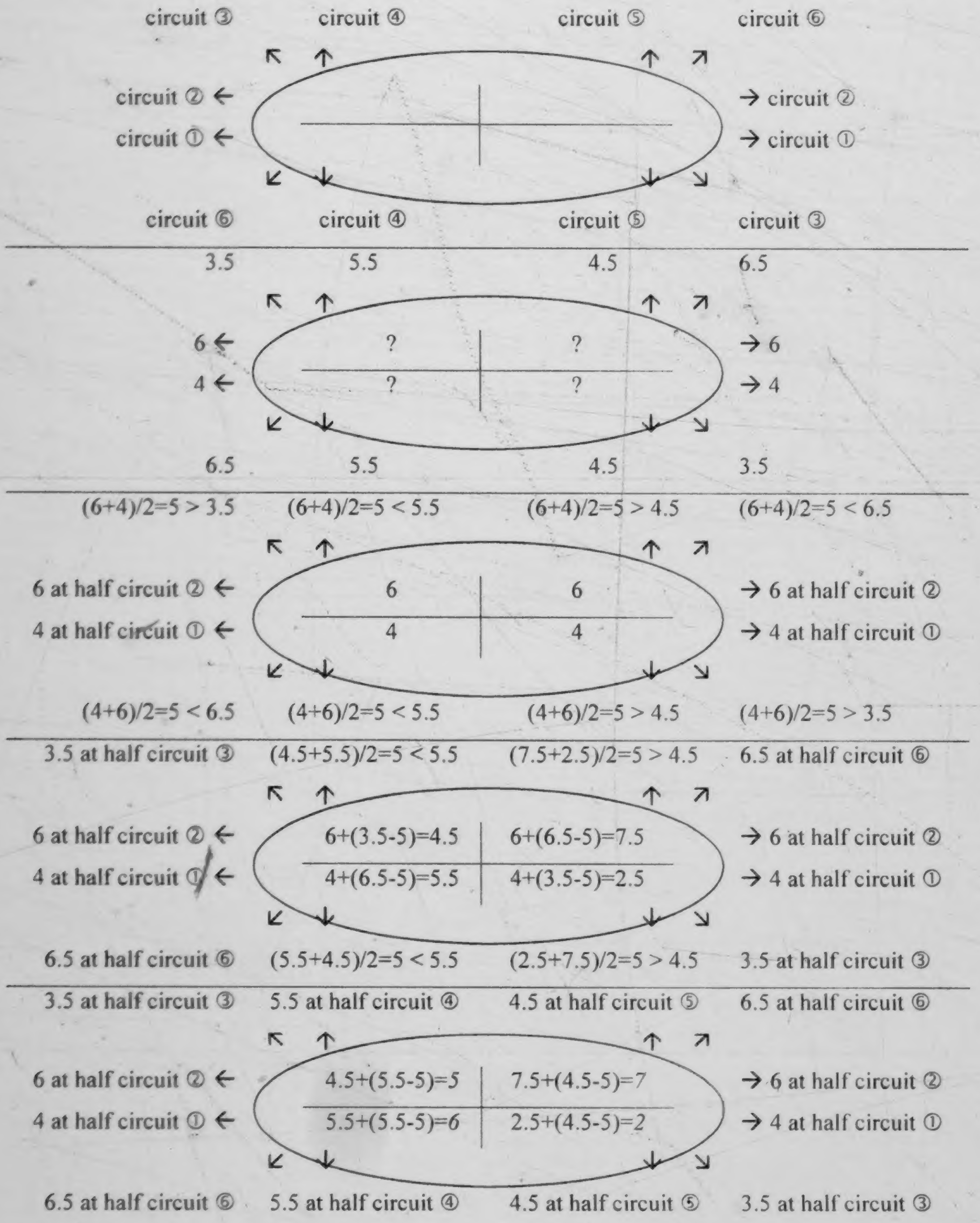
[423] George Hevesy and F. A. Paneth, *A Manual of Radioactivity* (London: Oxford University Press, 1938), 72; Martin Reivich, "Positron Emission Tomography," in *Encyclopedia of Neuroscience*, eds. George Adelman and Barry H. Smith (Amsterdam: Elsevier, 1999).

[424] Sten Carlsson, "A Glance at the History of Nuclear Medicine," *Acta Oncologica* 34 (1995): 1095-102.

[425] See for the latter; J. S. Fowler et al., "A Shielded Synthesis System for Production of 2-Deoxy-2-[^{18}F]fluoro-D-Glucose," *Journal of Nuclear Medicine* 22 (1981): 376-80.

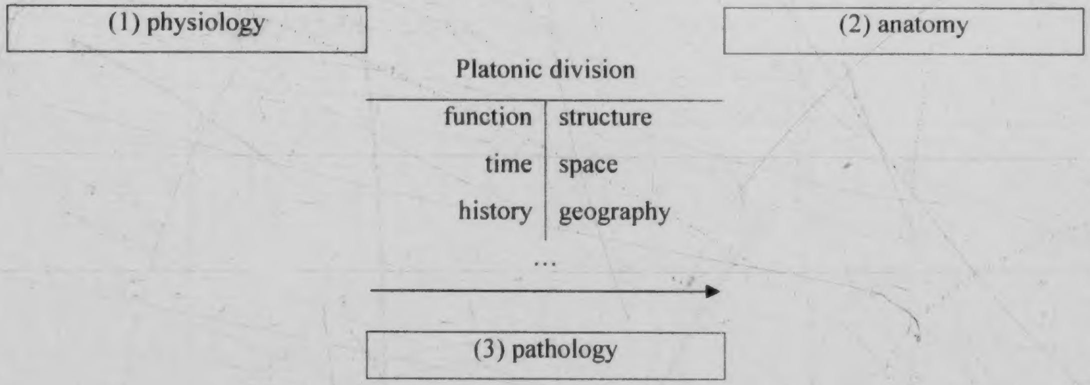
[426] A. M. J. Paans et al., "A Comparison of the Sensitivity of PET and NMR for In Vivo Quantitative Metabolic Imaging," *European Journal of Nuclear Medicine* 11 (1985): 73-75.

Figure 7. 3. 1-1. PET algorithm simplified



This annihilates the "physiological course vs. anatomic structure" dilemma: Claudius Galen in the 2nd century A.D. wrote about (1) how life keeps working (*Περι χρειας μοριων*)[427] separately from (2) how a body should be opened up once dead (*Περι ανατομικων εγχειρησεων*),[428] between which I can add yet another—(3) how one suffers from illness whether to death or not, i.e. pathology.[429]

Figure 7. 3. 1-2. Tripod of medical knowledge



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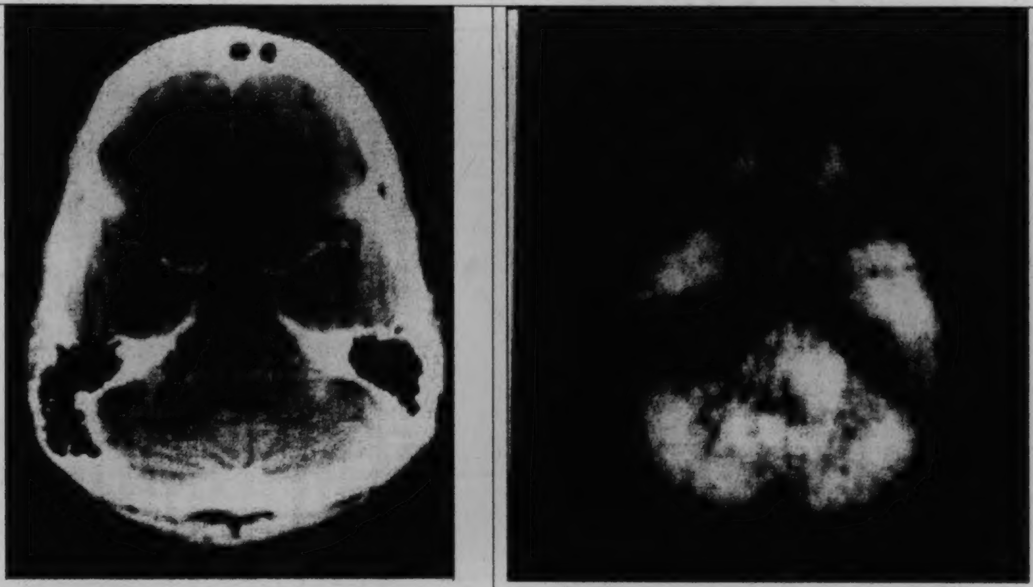
[427] Galen, *On the Usefulness of the Parts of the Body* (Ithaca: Cornell University Press, 1968).

[428] Galen, *On Anatomical Procedures* (London: Oxford University Press, 1956); against him, William Harvey proved two separate bundles of circulation (i.e. veins and arteries) in *Exercitatio anatomica de motu cordis et sanguinis in animalibus*, see http://www.fordham.edu/halsall/mod/1628harvey-blood.html

[429] Olga Amsterdamska and Anja Hiddinga, "The Analyzed Body," in *Medicine in the Twentieth Century*, eds. Roger Cooter and John Pickstone (Singapore: Harwood Academic Publishers, 2000), 419.

PET, moreover, has some prognostic value (see **5. 1**): an extraordinarily increased rate of glycosis indicates malignancy. Computed tomography can hardly forecast a patient's survival while illustrating her or his enlarged metencephalon (Figure 7. 3. 1-2; centre of each, surrounded by the fourth ventricle compressed backward) which PET, despite poor resolution, depicts as bright—meaning cancer: physicians do not have to wait certain weeks for the result of chemotherapies. A post-seizure reduction of activity, darkened in this case, would also help by warning them of another onset.

Figure 7. 3. 1-3. Scans of neoplasm: CT and PET[430]



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[430] Giovanni di Chiro, "Brain Imaging of Glucose Utilization in Cerebral Tumors," in *Brain Imaging and Brain Function*, ed. Louis Sokoloff (New York: Raven Press, 1985), 193-94; copyright by the Association for Research in Nervous and Mental Disease.

7. 3. 2. Iconology revisited (2)[431]

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[431] Presented at the International Association for Semiotic Studies, Imatra, June 2007; titled "Social Studies of Science? Semiotic Studies of Medicine!—A Case of Positron Emission Tomography." Abstract reads: Latourian quasi-discipline named *science studies*—even its second wave towards corporeality (e.g. *Body and Society*, v. 10)—omits numerous works on diagnostic imaging, which is not just because the humanities concerned with medicine already feature a vast enough corpus as Mario Biagioli who edited the reader decided to leave them out. There, laboratory erudition like biology is discussed rather than a set of bedside or clinical practices as evident in Hippocrates' aphorism: "life is short, the art (*techne*) long." Further, since a few decades ago when they called it *sociology of scientific knowledge*, science studies has referred to Algirdas Julien Greimas' notion of actor/actant, i.e. agency. Charles Sanders Peirce's semiotics, yet, seems more faithful to its symptomatological tradition and, besides, applicable to visual analysis. Anne Beaulieu's contribution explains how positron emission tomography, while consumed like pictures by a lay audience, maps the cerebral functions quantitatively. Her accounts can be rewritten: comprised of spots, PET measures where and how many isotopes have been concentrated *diagrammatically*, fulfilling some conditions for resemblance to a decreasing extent but against the myth—which Göran Sonesson fights—that *pure icons* would mimic perfectly no matter what they denote.

7. 3. 2. 1. Social studies of scien…tists?

> The almost total exclusion of materials from medicine and technology reflects the fact that history, sociology, and anthropology of medicine and technology are large and actively practiced fields whose literature is as sizeable as that of science studies itself. –Mario Biagioli, 1999

This editor of *The Science Studies Reader* might have made such a decision neither merely because size matters nor for convenience's sake. Intentionally or not, his reiterated juxtaposition of "medicine *and* technology" against science studies reflects another fact: Western medicine has been technology rather than a science ever since, for instance, hepatoscopy in 3000-2000 B.C.—deciphering the liver of a sheep into whose *in vivo* nose the sufferer has breathed, and inscribing whatever diagnosis on a hepato-shaped stone in cuneiform.[432] After the Hippocratic wisdom,[433] Aristotle—even among Hellenic rationalists—called medicine a sort of art (*ιατρικη τεχνη*; e.g. *Metaphysics*, 12. 1070a) or productive science (*ποιητικων επιστημων*) with its goal being health, unlike theoretical ones such as geometry only "to contemplate the nature" (*Eudemian Ethics*, 1. 1216b).[434] *Ars Medica* by Claudius Galen[435] followed this tradition.

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[432] Lisa Dziabis, "Glimpses of the Body's Interior," *Caduceus* 1 (1985): 42-50.

[433] Yun-Csang Ghimn, "A Formation of Classical Orientalism: Or, How the Hippocratic Writer(s) Dealt with the *Other*" (presented at the Canadian Communication Association, Toronto, May 2002); see **2. 2. 1**.

[434] Aristotle, http://www.perseus.tufts.edu (citation is to book. section)

[435] *Selected Works* (Oxford: Oxford University Press, 1997), 345-96.

I recognize that medical science has existed since continental researchers, like Claude Bernard of *Introduction à l'étude de la médicine expérimentale* and Rudolf Ludwig Karl Virchow of *Die Cellularpathologie* in the mid-19th century, started observing animals under control; for me, however, this scarcely equals performances e.g. *sickbed* examination. Science studies would often deal with isolated *laboratory* erudition including not just fractal physics,[436] but also biology: *Les Microbes* by Bruno Latour pertains to Louis Pasteur who was hardly a diagnostician,[437] Evelyn Fox Keller's *Making Sense of Life* features no signs of illness, and recent work by Nikolas Rose[438] has explored the ethical implications of pharmaco-genetic psychiatry—hence Foucauldian in line with *Folie et déraison* more than *Naissance de la clinique*.

When approaching medicine, science studies become *extra-scientific*: feminists have erroneously insisted that PET be short for posit*i*on (italicized by me) emission tomography[439] which truly utilizes posit*r*on.[440] Packaging various realms of the humanities concerned with science,[441] these critics would attempt to change or challenge something "while it is developing and flexible"[442] for any of its remote eventualities. I doubt whether their political commitments have been as well received as scientists' popular writing.[443]

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[436] Richard Wright, "Art and Science in Chaos: Contesting Readings of Scientific Visualization," in *FutureNatural: Nature, Science, Culture*, eds. George Robertson et al. (London: Routledge, 1996).

[437] Neurochemistry, another Latourian subject, drives backseat too; in *The Social Process of Scientific Investigation*, eds. Karin D. Knorr, Roger Krohn, and Richard Whitley (Dordrecht: D. Reidel Publishing Company, 1980-81), 53-73.

[438] For example, "Neurochemical Selves," *Society* 41 (2003): 46-59.

[439] Lisa Cartwright, "'Experiments of Destruction': Cinematic Inscriptions of Physiology," *Representations* 40 (1992): 129-52; Sarah Kember, *Virtual Anxiety: Photography, New Technologies and Subjectivity* (Manchester: Manchester University Press, 1998), 149; Janine Marchessault and Kim Sawchuk, eds. *Wild Science: Reading Feminism, Medicine and the Media* (London: Routledge, 2000), 256.

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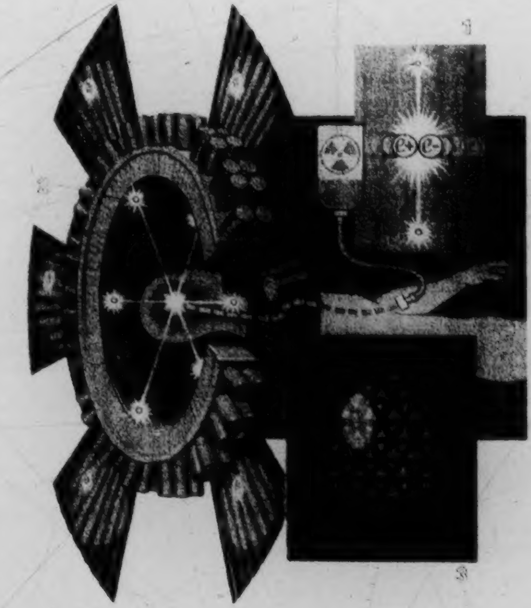
[440] An electron collides with its anti-particle carrying a + charge (i.e. positron) to be annihilated. Two γ rays thereof aim in the opposite directions (see **7. 3. 1**).



Howard Sochurek, "Medicine's New Vision," *National Geographic* 17 (1987): 2-41; reprinted with permission from Dr. Joel Karp, the source.

[441] Margaret Lock et al., *Living and Working with the New Medical Technologies: Intersections of Inquiry* (Cambridge: Cambirdge University Press, 2000), 1-3.

[442] Deborah Blizzard, "Situating Fetoscopy within Medical Literature and Lived Experience: An Opening for Social Analysis," in *Bodies of Technology: Women's Involvement with Reproductive Medicine*, eds. Ann Rudinow Saetnan, Nelly Oudshoorn, and Marta Kirejczyk (Columbus: Ohio State University Press, 2000), 410.

[443] For a memoir on how computerized axial tomography was born, see G. R. Higson, "The Beginning of CT Scanning—A Personal Recollection," *Bulletin of the British Institute of Radiology* 5 (1979): 3-4.

7. 3. 2. 2. It takes Dutch

Evident with half the number of contributors to a *Body and Society* issue (v. 10, nos. 2-3), the second wave of science studies bends towards corporeality.[444] This trend is led by promising Dutch authors: José van Dijck has gathered papers highlighting the points where the gaze coming from media interests, and that being applied for surgical purposes converge. Since differences between those lenses are still clearly admitted,[445] nothing approaching metaphorical similarity[446] could satisfy readers—neither is her monograph concerning such a synchronicity as compact discs triggering off the respective progress of music industry and cardiovascular scanning. To say that CAT needs computers would also be a mere tautology. Instead, she discusses how both technological sectors have frequently met: for example, x-ray photographs were made popular to help the promotion for respiratory health, while documented separations of

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[444] This label which Bruno Latour used for Marc Berg and Annemarie Mol's *Difference in Medicine* has not sold to H. M. Collins and Robert Evans who distinguish three waves: first the pre-Thomas Kuhn one, secondly any sociological imaginations and finally their own initiative on advising specialized knowledge for public affairs: "The Third Wave of Science Studies: Studies of Expertise and Experience," *Social Studies of Science* 32 (2002): 235-96.

[445] J. van Dijck, *The Transparent Body: A Cultural Analysis of Medical Imaging* (Seattle: University of Washington Press, 2005), 11.

[446] "Indeed, just as medical progress, the possibility of radiography, scanners, and grafts, transforms our body and our relationship to our body, media space, whether we are spectators or actors, in one way or another, implies a profound transformation of the body and of our relationship to our own body," says Jacques Derrida to Bernard Stiegler, *Echographies of Television: Filmed Interviews* (Cambridge: Polity, 2002), 96.

Siamese twins or the Visible Human Project[447] became a spectacle in Guy Debord's sense. Endoscopy hence parallels not so much any communication gadgetry *per se* as it does science fiction.

A chapter in which van Dijck compares roentgenography with a Nobel Prize winner by Thomas Mann is unique at certain points. Firstly, her choice of *The Magic Mountain* leads into questioning how broadly she defines media. Then, we realize that the contents—rather than materiality—of Mann's novel matter: just like a hardcover book, *Fantastic Voyage* by Otto Klement and Jay Lewis Bixby might be enough to report endoscopic desires around 1966 as the Richard Fleischer movie debuted. Third, when van Dijck writes, "Part of the X ray's power rested in its ability to 'speak for itself,' to offer a representation of the inner body apart from its referent in time and space, thus opening it up for intersubjective perception. In that respect, Röntgen's device resembles a contemporary technological invention: the gramophone," she cites *Grammophon, Film, Typewriter* [1986] by Friedrich A. Kittler[448] whose stoic two-dimensional inscription theory (see **2. 1. 2. 3**) looks to be more favoured than Bruno Latour's. Is van Dijck's exposition shifting from science studies to media archaeology, yet another perspective on medical instruments? That seems unlikely, because she invites no such Foucauldian word-before-thing media as Siegfried Zielinski does some 18th-century remote typewriter which did not actually exist (see **6. 2. 2. 2**). *Fantastic Voyage* epitomizes discursive inventions of diagnostic apparatus popularized in the media. Another case for Zielinski is Jan Evangelista Purkyně's doctoral thesis apropos of subjective vision featuring optical tools like kaleidoscopy, a technology from the same century.[449] If van Dijck found new ideas which ironically appeared to somehow transcend historical contexts as recommended by Erkki Huhtamo,[450] van Dijck would seek any literary attention before 1895 to non-invasive anatomy or place films such as *Fantastic Voyage*, *Innerspace* and *Osmosis Jones* recurring every second decade vis-à-vis treatment with miniaturized agents that we have never witnessed.

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[447] Certain feminists protest that a man has no moral right to surrender his deceased spouse but that, once her body is donated, she deserves as much attention as Joseph Paul Jernigan, an executed male; Catherine Waldby, *The Visible Human Project: Informatic Bodies and Posthuman Medicine* (London: Routledge, 2000), 1-18. I contend, however, that the woman's condition of heart failure was rarely emphasized. Based upon normal cadavers, this regressive VHP ignores, like people before Giambattista Morgagni, how and why—*vera causa*—she has died.

[448] See van Dijck, 88, 161 n.

7. 3. 2. 3. Which semiotics of medicine?

> Whatever acts or shifts actions, action itself being defined by a list of performances through trials; from these performances are deduced a set of competences with which the actant is endowed; the fusion point of a metal is a trial through which the strength of an alloy is defined; the bankruptcy of a company is a trial through which the faithfulness of an ally may be defined; an

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[449] S. Zielinski, *Deep Time of the Media: Toward an Archaeology of Hearing and Seeing by Technical Means* (Cambridge: The MIT Press, 2006).

[450] "From Kaleidoscomaniac to Cybernerd: Notes toward an Archeology of the Media," in *Electronic Culture: Technology and Visual Representation*, ed. Timothy Druckrey (New York: Aperture, 1996).

actor is an actant endowed with a character (usually anthropomorphic). – Madeleine Akrich and Bruno Latour[451]

Despite those aforementioned rarities,[452] *science studiests* (my designation) appear to be sociologists rather than *students of science* let alone medical technology; hence the label sounds problematic, which is more so because I have never heard of *medicine*—not *medical*—*studies*. Clinical practices may be of no concern unless they appeal to science *and technology* studies. Likewise, social thinkers or anthropologists of the body[453] have cared little about diagnostic imaging. When determined to chase laboriously how inequalities are strategically depicted as steady by the power machine, Gordon Fyfe and John Law continued participating in leftist politics: "To understand a visualisation is thus to inquire into its provenance and into the social work that it does. It is to note its principles of exclusion and inclusion, to detect the roles that it makes available, to understand the way in which they are distributed, and to decode the hierarchies and differences that it naturalises. And it is also to analyse the ways in which authorship is constructed or concealed and the sense of audience is realised."[454]

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[451] "A Summary of a Convenient Vocabulary for the Semiotics of Human and Nonhuman Assemblies," in *Shaping Technology/Building Society*, eds. Wiebe E. Bijker and John Law (Cambridge: The MIT Press, 1992), 259.

[452] Latour and Steve Woolgar ask in the second edition of *Laboratory Life*: "how useful is it once we accept that *all* interactions are social? What does the term 'social' convey when it refers equally to a pen's inscription on graph paper, to the construction of a text and to the gradual elaboration of an amino-acid chain?" Their own answer follows: "Not a lot. By demonstrating its pervasive applicability, the social study of science has rendered 'social' devoid of any meaning." Therefore its subtitle *The Social Construction of Scientific Facts* gets shortened; *Laboratory Life: The Construction of Scientific Facts* (Princeton: Princeton University Press, 1986), 281.

[453] For example, Ted Polhemus, *The Body Reader: Social Aspects of the Human Body* (New York: Pantheon, 1978); Emily Martin, "The End of the Body?," *American Ethnologist* 19 (1992): 121-40; Mike Featherstone, Mike Hepworth, and Bryan S. Turner, *The Body: Social Process and Cultural Theory* (London: Sage, 1993); Chris Shilling, *The Body and Social Theory* (London: Sage, 1994).

Semiotic influences come to mind next, although they are seldom recognized.[455] Speaking genealogically, sociologists of scientific knowledge or actor-network theorists have favoured the Greimassian notion of *actant* that was borrowed from Lucien Tesnière as referring to any noun (*substantif*) which engages in the predicated event (*procès*) and becomes a human or equivalent actor.[456] This linguist investigated how expressive grammar signifies real-life contents; to *École-de-Paris* semioticians, it matters that Vladimir Propp's several *dramatis personae*[457] were replaced with fewer categories.

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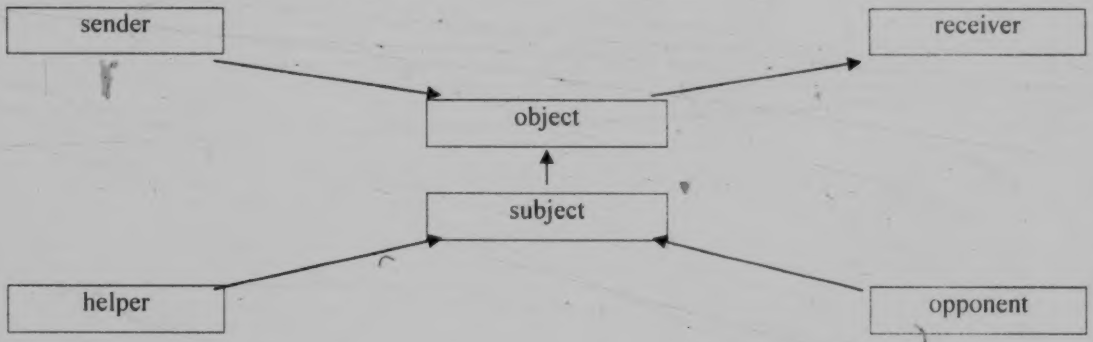
[454] G. Fyfe and J. Law, *Picturing Power: Visual Depiction and Social Relations* (London: Routledge, 1988), 1.

[455] Bernike Pasveer exceptionally reveals the possible equivocality of radiographs: i.e. people interpret stuff diversely at their discretion. "Knowledge of Shadows: The Introduction of X-ray Images in Medicine," *Sociology of Health & Illness* 11 (1989): 360-81; see **6. 1**.

[456] L. Tesnière, *Éléments de syntaxe structurale* (Paris: Klincksieck, 1976), 102.

[457] The villain, donor, helper, princess/her father, dispatcher, hero, false hero; see V. Propp, *Morphology of the Folktale* (Austin: University of Texas Press, 1984).

Figure 7. 3. 2. 3-1. Actantial model[458]



Algirdas Julien Greimas proceeded to exclude the bottom row for being *auxiliant* in "La Soupe au pistou ou la construction d'un objet de valeur" [1979] and projected a protagonist on such modal verbs as—since "Les Actants, les acteurs et les figures" was published 6 years earlier—*vouloir* (wanting) *pouvoir* (being able) *savoir* (knowing) and, in "Pour une Théorie des modalités" ['76], *devoir* (having to).[459] Though animals or things such as diamonds are often sought after,[460] they may not so much assume those heroic positions. Greimassian actants have turned out more of the subject i.e. social agent (in French, *actant*) which science studiests have adopted for longer than it appears to be internationally confirmed.[461] Latour and Paolo Fabbri in 1977 co-wrote "La Rhétorique de la science: Pouvoir et devoir dans un article de science exacte"[462] that was appreciated by Jean-Claude Coquet, a Parisian scholar.[463] This clan gave birth to sociology of scientific knowledge or *actor-network theory*, if not François Rastier et al's information semiotics![464] However, with its three words and the all intimidating hyphen,[465] ANT may be a misnomer of the agency-structure debate,[466] according to which actants themselves achieve society rather than having been within or constructed by society *a priori*.[467]

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[458] Joseph Courtés, *Introduction à la sémiotique narrative et discursive: Méthodologie et application* (Paris: Hachette, 1976), 62-68.

[459] Translated respectively into *Paris School Semiotics II. Practice*, eds. Paul Perron and Frank Collins (Amsterdam: John Benjamins Pub., 1989), 1-12 and two chapters of A. J. Greimas, *On Meaning: Selected Writings in Semiotic Theory* (Markham: Fitzhenry & Whiteside Limited, 1987), 106-39.

[460] Gerald Prince, *A Dictionary of Narratology* (Lincoln: University of Nebraska Press, 2003), 2.

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[461] Timothy Lenoir, "Was the Last Turn the Right Turn? The Semiotic Turn and A. J. Greimas," *Configurations* 2 (1994): 119-36.

[462] This unsung Latourian piece on how scientists compose their reports is translated in the Canadian Association of Teachers of Technical Writing journal *Technostyle* 16 (2000): 115-34.

[463] J.-C. Coquet, *Le Discours et son sujet 1. Essai de grammaire modale* (Paris: Klincksieck, 1984).

[464] Their neologism reminds me of Latour's (see **2. 1. 2. 1**)—

actant: semic cluster that includes a case seme.

seme cluster (or *semic molecule*): stable grouping of semes, not necessarily lexicalized, or whose lexicalization can vary.

seme: element of a sememe, defined as the extreme of a binary relational function between sememes.

sememe: signified of a morpheme.

signified: content of a linguistic unit.

content: plane of the text comprised by the totality of signifieds.

text: autonomous linguistic string that constitutes an empirical unit and that is produced by one or more enunciators in a given social practice.

social practice: codified activity, which puts into play specific relations between the semiotic sphere, the sphere of mental representations, and the physical sphere.

morpheme: the minimal sign, undecomposable in a given synchronic state.

actor: unit of the evenemential level of the dialectic component, composed of a semic molecule to which roles are associated.

evenemential level: level of dialectics constituted by actors and functions.

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dialectic: semantic component that articulates the succession of intervals in textual time.

component: a systematic instance which, being in interaction with other instances of the same order, regulates the production and interpretation of linguistic chains.

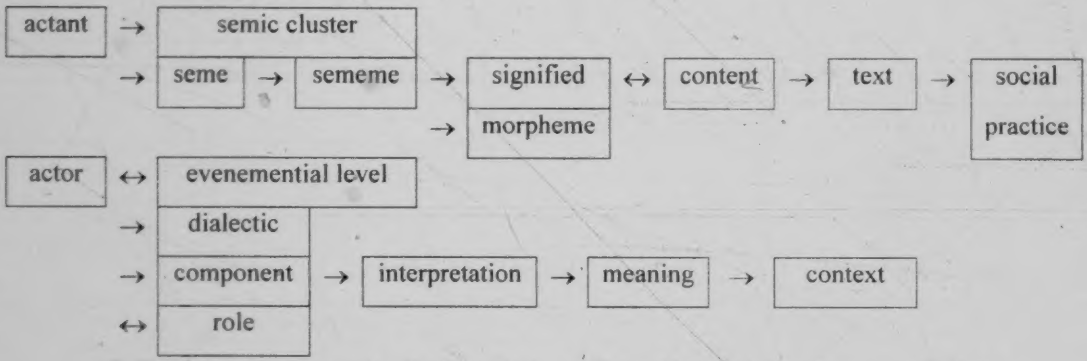
interpretation: the assigning of meaning to a linguistic chain.

meaning: content of a linguistic unit, defined in terms that are relative to its context and communicational situation.

context: for a given semantic unit, the totality of units that have an influence on it, and on which it has an influence.

role: elementary dialectic valence of an actor.

To recap this glossary:



F. Rastier et al., *Semantics for Descriptions: From Linguistics to Computer Science* (Stanford: CSLI, 2002), 255-60.

[465] A jaded Latour renames his own contribution "On Actor-network Theory" [1996] to *Soziale Welt* as "The Trouble with Actor Network Theory" [1997] in *Actor Network Theory and After*, eds. John Law and John Hassard (Oxford: Blackwell Publishers, 1999), 25.

[466] Latour involves "actants" to be humanized (*anthropomorphism*) while Greimas and Courtés expel such automatons without *savoir* from communication; *Semiotics and Language: An Analytical Dictionary* (Bloomington: Indiana University Press, 1982), 302.

7. 3. 2. 4. It takes Dutch, and others

Anne Beaulieu has contrasted three players in positron emission tomography: first, psychological researchers understand that it statistically measures the cerebral functions. Secondly, a lay audience would consume the scan like beautiful paintings or photos so misleadingly realistic some have created ungrounded expectations for clairvoyance while its image data are enormously hard to read as evidence of character traits.[468] Third—and this particularity explains why science (or scientists whom Beaulieu has described as reliant upon numbers and texts rather) studies does not suffice—a clinician requires such rendering of data to communicate with his or her patient.[469] Here we have Algirdas Julien Greimas' subject, receiver, sender (Figure 7. 3. 2. 3-1); tomographs are no actantial machinery serving people modestly,[470] but objectified for

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[467] S. S. Strum and Latour, "Redefining the Social Link: From Baboons to Humans," *Social Science Information* 26 (1987): 783-802.

[468] Bärbel Hüsing et al. *Impact Assessment of Neuroimaging: Final Report of the Centre for Technology Assessment* (Zurich: vdf, 2006).

[469] A. Beaulieu, "Images Are Not the (Only) Truth: Brain Mapping, Visual Knowledge, and Iconoclasm," *Science, Technology, & Human Values* 27 (2002): 53-86.

[470] Jim Johnson (of Columbus, Ohio i.e. Latour's anglophone pseudonym), "Mixing Humans and Nonhumans Together: The Sociology of a Door-closer," in *Ecologies of Knowledge: Work and Politics in Science and Technology*, ed. Susan Leigh Star (Albany: State University of New York Press, 1995); in Parisian semiotics—the door can be open (situation), was not yet so then it has been opened (event) or the door flies open (process), but somebody must still make that happen (action) by opening it. Gérard Genot, *Elements of Narrativics: Grammar in Narrative, Narrative in Grammar* (Hamburg: Buske, 1979), 20. Does the closer *know* what to do and *want* that?

visual analysis to which I find Charles Sanders Peirce faithful.[471] Let us paraphrase Beaulieu's accounts: PET, comprised of pixels, calculates where and how many isotopes are concentrated *diagrammatically*. Göran Sonesson considers this cartography[472] more

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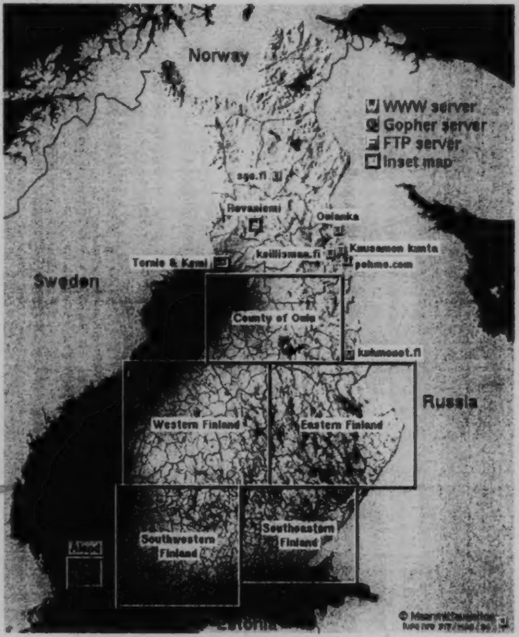
[471] See for Hippocrates' symptomatological legacy; Yun-Csang Ghimn, "Visual and Linguistic Communication in the History of Medicine—From Semiotics in Medicine to Semiotics of Pain," *Visio* 8 (2003): 275-83.

[472] In this map, the darker yellow or even brown—which corresponds to nothing of that colour—the hillier where three Scandinavian countries meet; the brighter and greener southbound, the lower Finland—relatively speaking (http://www.nic.funet.fi/resources/maps/). *Diagram* could be further categorized into simple *geometrical figure*, *algebraic precept* and *graph* mixing both: Frederik Stjernfelt, *Diagrammaticality: An Investigation on the Boundaries of Phenomenology, Ontology, and Semiotics* (Dordrecht: Springer, 2007), 89-116. Stjernfelt considers the first of them, i.e. map, linear but my pointillist examples "to recognize landscape forms" preserve height (right) or metabolism (PET) rather than area, distance or connexity. See also C. S. Peirce, *Collected Papers* (Cambridge: Harvard University Press, 1931-35 & 1958), Volume II, paragraph 216 (citation is to *CP* Volume. paragraph).



fulfilling than *image* or *metaphor*,[473] two other kinds of *iconicity* that does not mimic things so much as exhibits how the structure is proportionally arranged.[474]

Why subdivide (*hypo*)*icon* there into those *diagram* and *metaphor* concepts?[475] Firstly, it is a myth that *images* or pure *icons* would amount to the perfect double of whatever they denote. Peircianism has already fought non-semiotic, though ordinary, examples of computer-graphic and Orthodox-church "icon" which look *symbolic*.[476] Next, just like *indices* are the core sign,[477] *diagrams* characterize a condition termed *iconicity* that some, even decreasing, extent of resemblance could satisfy: the famous triplet went in 1885 without designating *symbol*—

> The first is the diagrammatic sign or *icon*, which exhibits a similarity or analogy to the subject of discourse; the second is the *index*, which like a pronoun demonstrative or relative, forces the attention to the particular object intended without describing it; the third is the general name or description which signifies

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[473] G. Sonesson, "Iconicity in the Ecology of Semiosis," in *Iconicity—A Fundamental Problem in Semiotics*, eds. Troels Degn Johansson, Martin Skov and Berit Brogaard (Åhrus: Nordic Summer University Press, 1999). See also **4. 2**.

[474] *CP* IV. 544.

[475] *CP* II. 277.

[476] Jerzy Pelc, "Iconicity: Iconic Signs or Iconic Uses of Signs?" in *Iconicity: Essays on the Nature of Culture*, eds. Paul Bouissac et al. (Tübingen: Stauffenburg, 1986), 7.

[477] To become a sign, it "must have a real physical connection with the thing it signifies so as to be affected by that thing. A weather-cock, which is a sign of the direction of the wind, must really turn with the wind." *CP* VII. 356.

> its object by means of an association if ideas or habitual connection between the name and the character signified.[478]

Bruno Latour sounds less Greimassian when saying not only "they can point with their fingers to phenomena taken in by the eye [...] the 'index' par excellence" but also "Is the diagram [...] more abstract or more concrete than our previous stages? More abstract, since here an infinitesimal fraction of the original situation is preserved; more concrete, since we can grasp in our hands, and see with our eyes, the essence of the forest-savanna transition, summarized in a few lines. Is the diagram a construction, a discovery, an invention, or a convention? All four, as always."[479] Regarding rhetorically generated credibility, the concepts of "selective" perception—i.e. filtering, uniforming, upgrading, defining—by Michael Lynch[480] and the "homologues" demonstration by Peter Galison, which retains internal relations of what has been represented,[481] seem compatible with Peirce's *diagram* too.

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[478] *CP* I. 369.

[479] B. Latour, *Pandora's Hope: Essays on the Reality of Science Studies* (Cambridge: Harvard University Press, 1999), 29 & 66.

[480] "The Externalized Retina: Selection and Mathematization in the Visual Documentation of Objects in the Life Sciences," *Human Studies* 11 (1988): 201-34.

[481] P. Galison, *Image & Logic: A Material Culture of Microphysics* (Chicago: University of Chicago Press, 1997).

I have proposed a thesis on diagnostic images to prove the consistent *diagrammaticality* from pre-modern autopsy drawing[482] to PET, where science studies turns out disappointing again: it rarely does medical "technology" justice. Greimas' actant scheme that underlies Latourian sociology of scientific knowledge once comprised personified "objects" in *Sémantique structurale* [1966] but has soon focused on asking what a "subject" can, must, wants and knows (how) to do: henceforth *sémiotique des passions* later. Tomographers operate i.e. upon our sensate body[483] without a scalpel, PET

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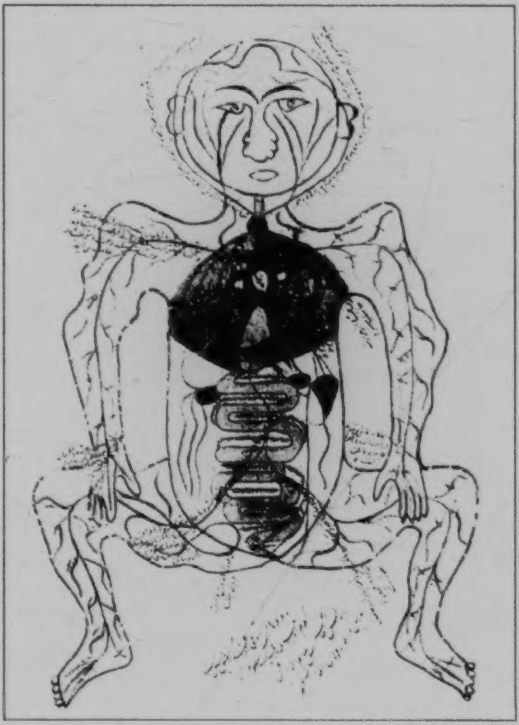
[482] See **4. 2. 1.**

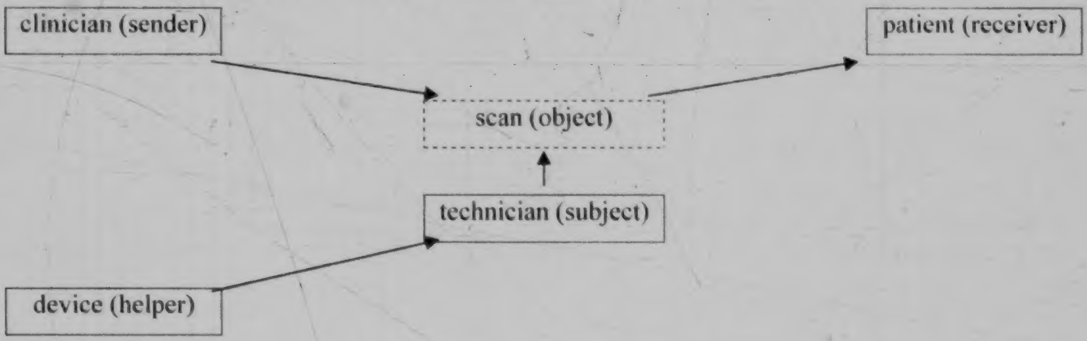


Mansur ibn Ilyas, *Tashrih-i badan-i insan*, Manuscript P 19, Folio 18a. http://www.nlm.nih.gov/exhibition/dreamanatomy/da_g_X-2.html, a U.S. National Library of Medicine site.

[483] A. J. Greimas and Jacques Fontanille, *The Semiotics of Passions: From States of Affairs to States of Feeling* (Minneapolis: University of Minnesota Press, 1993), xxii. This inconclusive project has succeeded to Louis Hjelmslev's mission in *Prolegomena to a Theory of Language*—how to fragment a continuum. Anne Hénault, *Histoire de la sémiotique* (Paris: Presses Universitaires de France, 1992), 116-19; see **7. 1. 1**.

instrumentation helps wherein patients experience the procedure; yet, tomographs are rather acted or practiced on by those expert agents (Figure 7. 3. 2. 4-1 where scans mediate a doctor-engineer-client power game). Latour would not call such PET inscriptions *actors* either, but *diagrams*. If one assesses medical signs, Peirce shall help; to study how scientists act sociologically, there is Greimassian semiotics. Another matter of choice goes: computerized axial tomography for bones, nuclear magnetic resonance imaging for the soft tissue and PET for neural substructures.

Figure 7. 3. 2. 4-1. Actantial model applied to visual diagnosis



8. Virtual medicine[484]

I presented a triadic model for semeiotic imaging à la Charles Sanders Peirce i.e. ① illness ② signs ③ diagnosis plus—between secondness and thirdness—spatial virtualization (see Figure 3. 1. 4-1). In practice, this means that perceptible indications of sickness, the Stoic bodily event, *leave* a patient for her/his physician to interpret them. Hence both participants that used to actually meet can now be physically distanced from each other: many doctors have become less approachable. Or alternately, communication technologies may bring a once far medical practitioner closer to whoever needs to be examined—if not vice versa by the telecommunication of mobile inscriptions[485] like computerized tomography—on screens. Let me discuss two ethically different implications. The non-visual auditory sense well serves for the examples.[486]

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[484] To be presented at the Doctoral Colloquium – Internet Research 9.0, Copenhagen, October 2008; entitled "Telemedicine: A Pre-web History."

[485] Bruno Latour and Steve Woolgar had considered the nuclear magnetic resonance spectrometer too large to be an inscription device; see *Laboratory Life: The Social Construction of Scientific Facts* (Beverly Hills: Sage Publications, 1979), 89. However, the definition would later include "any set-up, no matter what its size" in Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge: Harvard University Press, 1987), 68.

[486] Treatment is not featured throughout my dissertation; see Timothy Lenoir, "The Virtual Surgeon: Operating on the Data in an Age of Medialization," in *Semiotic Flesh: Information & the Human Body*, eds. Phillip Thurtle and Robert Mitchell (Seattle: Walter Chapin Simpson Center for the Humanities, 2002).

8. 1. Centrifugal diagnosis

8. 1. 1. Mediated auscultation

> There was a young man in Boston town, / He bought him a stethoscope nice and new, / All mounted and finished and polished down, / With an ivory cap and a stopper too.
> It happened a spider within did crawl, / And spun him a web of ample size, / Wherein there chanced one day to fall / A couple of very imprudent flies.
> The first was a bottle-fly, big and blue, / The second was smaller, and thin and long; / So there was a concert between the two, / Like an octave flute and a tavern gong.
> Now being from Paris but recently, / This fine young man would show his skill; / And so they gave him, his hand to try, / A hospital patient extremely ill.
> –Oliver Wendell Holmes, "The Stethoscope Song" [1848][487]

Why is this little stethoscopic tool such a revolutionary one? Hippocrates already pressed his ear upon another person's thorax in order to describe certain sounds therefrom as vinegar boiling inside.[488] Robert Hooke insisted:

> There may be also a Possibility of discovering the Internal Motions and Actions of Bodies by the sound they make [...] And somewhat more of Incouragement I have also from Experience, that I have been able to hear very plainly the beating of a Man's Heart, and 'tis common to hear the Motion of Wind to and fro in the

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[487] http://www.ibiblio.org/eldritch/owh/steth.html

[488] Hippocrates, *Diseases II* (London: William Heinemann, 1923-88), chapter 61.

> Guts, and other small Vessels, the stopping of the Lungs is easily discover'd by the Wheesing, the Stopping of the Head, by the humming and whistling Noises, the fliping to and fro of the Joynts in many cases, by crackling, and the like.[489]

Gaspard Laurent Bayle, a pupil of Jean Nicolas Corvisart des Marets, also practised direct auscultation. But it was not always common. There were hygienic reasons i.e. fear of contagion; the question remains, why so revolutionary?

René Théophile Hyacinthe Laënnec pondered the need for a technique better than simply placing his own head against the bosom of an obese lady (see **3. 2**) and noticed a child scratching one end of some timber while his playmate listened at the other end. Its application must have been evident to Laënnec's searching mind because he rushed back to anxiously examine her chest and heart in a similar way—thus his invention which nonetheless was at first received with antipathy: John Forbes wrote, "there is something even ludicrous in the picture of a grave physician formally listening through a long tube applied to the patient's thorax, as if the disease within were a living being that could communicate its condition to the sense without" in his English foreword to *De l'Auscultation médiate ou traité du diagnostic des maladies des poumons et du coeur*.[490]

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[489] R. Hooke, *The Posthumous Works* (London: Sam. Smith and Benj. Walford, 1705), 39.

[490] R. T. H. Laennec, *A Treatise on the Diseases of the Chest: In Which They Are Described According to Their Anatomical Characters, and Their Diagnosis Established on a New Principle by Means of Acoustick Instruments, with Plates* (London: T. and G. Underwood, 1821), xix.

Augustus Bozzi Granville told another famous story where Laënnec rolled up a student's *cahier des visites* in the shape of a cylinder by sheer chance.[491]

Yet doctors were loath to also touch dirty ward patients: under Bayle's guidance, Laënnec studied early-tubercle-inducing-late-phthisis (i.e. the perennial cause of adult death) to which both would eventually succumb themselves after carrying its various symptoms for a while. Why risk spreading any pestilences, however aestheticized,[492] by contact? It was as important to fasten the stethoscopic batons with an extended string as their material of fabrication also mattered—paper or wood (e.g. teak, beech, linden)—and how distinctively one could hear via the devices. Laënnec's artistry widened a gulf between the sick and their diagnosticians who, given a new set of exclusive knowledge, would dominate the relationship. Stethoscopy helped clinicians withdraw from involvement with their patients' testimony but move towards a more detached representation of sounds. To avoid background noises in his quest for signs, which displaced interrogation or history-taking, the particular region was embarrassingly undressed; privacy and modesty vanished.

Pierre Adolphe Piorry introduced an ivory plate to knock with the fingers or a hammer once placing that against the subjected areas,[493] but its adoption was promptly extinguished. He must bend over certain repulsive patients just as Leopold Auenbrugger had done using a glove in the 18th century. Laënnec stroked them gently by a stethoscope in order to combine hand and ear. Why did this gadget develop with numerous modifications including the binaural headset, narrower stem, bell and diaphragm[494] while Piorry's method not? Perhaps indirect auscultation guaranteed some *healthy* distance that doctors' feeling of tactility from his flat device scarcely bridged (see Figure 8. 2. 2-1).

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[491] See for example Peter R. Fleming, *A Short History of Cardiology* (Amsterdam: Rodopi, 1997), 88.

[492] Clark Lawlor, *Consumption and Literature: The Making of the Romantic Disease* (New York: Palgrave Macmillan, 2007).

[493] P. A. Piorry, *De la Percussion médiate et des signes obtenus à l'aide de ce nouveau moyen d'exploration dans les maladies des organes thoraciques et abdominaux* (Paris: J. S. Chaude, 1828), 14 ff.

S. G. Brown in London devised, according to *Scientific American* in 1910, a telephonic stethoscope depending on the electrons' airborne flow between two conducting surfaces at different potentials: such a relay magnifies the currents passing through about 60 times. It was attached to a wire service, through which physicians heard the heart beats from a person in the Isle of Wight. This removed geographical constraints and created service opportunities for rural practitioners too isolated to afford them.

8. 1. 2. Variola pictures revisited

Hermann Wilhelm Vogel's episode published in 1874 reads: "A lady was photographed at Berlin, whose face had never presented specks in photography. To the surprise of the photographer, on taking her portrait specks appeared that were invisible in the original. A day later the lady sickened of the small-pox, and the specks at first invisible to the eye, became then quite apparent." He had noticed by chance dark spots on the picture of a healthy-looking woman before they actually came out. My inquiry has taken some initial steps in **Chapter 5**: first, why did the seemingly ultra-violet apparatus that made Vogel see this otherwise latent sign of illness remain unknown to doctors? Our chemist/portraitist would seldom examine patients but merely retouch their snapshots. The medical gazes meant "outside looking in" to him; as per depth, UV can hardly match x-rays, an innovation which came two decades later. Secondly, regarding temporality, even if Vogel's medium had been known, would those rationalist diagnosticians of German laboratories rather than empiricist prognosticians of French hospitals of the era have welcomed it? Just as Roland Barthes muses about his dead mother's *avoir-été-là* on her funeral picture, so Vogel saw one dying Frau's *sera-là*. Both are ghostly spectra emanating from a *thanato-graph*.

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[494] Morton Donald Blaufox, *An Ear to the Chest: Evolution of the Stethoscope* (London: The Parthenon Publishing Group, 2002).

Fear or therapeutic defeatism over this often fatal and incurable malady[495] partially explains why the promising technology was not selected but instead was succeeded by photographic retouching. Without enough field witnesses, painters like Félix Méheux (Figure 8. 1. 2-1) manipulated the colours of eruptive rash: a lesion on the slimy membranes (e.g. mouth, tongue, palate and pharynx) or on the skin, reddish or rather opalescent, sheds damaged epithelial cells. Suspected patients must be quarantined; if not, as we concede that even tuberculosis has a lower morbidity rate than smallpox does, all her/his near contacts should wear protective clothing and be put under surveillance. Vaccination turns out to be too little too late if any stock of laboratory virus grown in scarified calves is available: because the World Health Organization's inoculation project ceased a whole generation ago, much of the current global population has gone through no routine immunization. Yet, given within 4 days of initial contamination, it offers moderate protection. Antibiotics can be effective against bacterial complications only. Better safe than sorry, I understand this centrifugal motive—why take a chance? Looks could kill; stay away from variola.

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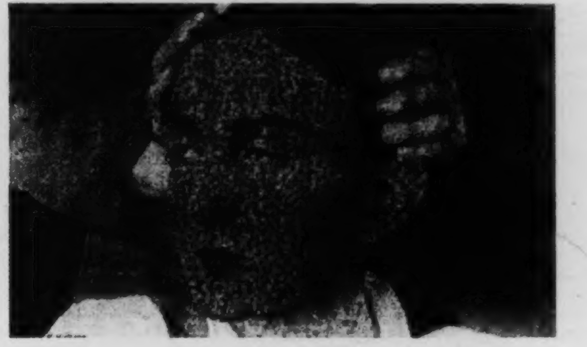
[495] See for example Alfred W. Crosby, "Smallpox," in *The Cambridge Historical Dictionary of Disease*, ed. Kenneth F. Kiple (Cambridge: Cambridge University Press, 2003).

Figure 8. 1. 2-1. Hand tinted photograph of a face with smallpox[496]



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[496] William Thomas Corlett, *A Treatise on the Acute, Infectious Exanthemata: Including Variola, Rubeola, Scarlatina, Rubella, Varicella, and Vaccina, with Especial Reference to Diagnosis and Treatment* (Philadelphia: F. A. Davis Company, 1902), 40.

8. 1. 3. Teleoroentgenography vs. tele-radiography?

> Radiation presents two medical hazards. It will give some people ulcers from worrying about it, and it will give other people ulcers from worrying about the people who worry about radiation.
>
> –Edward Teller, talk before a conference on disaster care[497]

They measured the size or shape of a heart as the patient and chest film are positioned 180-210 cm off the cathode tube—named after Sir William Crookes or soon William David Coolidge—a distance much greater than used for time-consuming fluoroscopy until the 1960s.[498] A linked issue concerns the operators' exposure to radioactivity.[499] Its side effects include cancer, which is expected not only detectable but ironically also curable by x-rays, while advocates embraced amplification.[500] Viewed instantaneously on a mirror or monitor, the fluoroscopic image requires a higher dosage and puts radiologists who are engaged closely with the sick at risk. But do I think a room 6-7 feet away was remote enough to qualify as *tele*-roentgenography? Bettyann

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[497] Quoted in Emanuel R. N. Grigg, *The Trail of the Invisible Light: From X-Strahlen to Radio-(bio)logy* (Springfield: Charles C Thomas, 1965), ix.

[498] Robert N. Cooley and Melvyn H. Schreiber, *Radiology of the Heart and Great Vessels* (Baltimore: Williams and Wilkins, 1978), 5.

[499] See for example G. M. Ardran, "The Society and X-ray Protection," *Radiography* 37 (1971): 157-65.

[500] Otto Glasser, "Technical Development of Radiology: 1906-1956," *American Journal of Roentgenology, Radium Therapy and Nuclear Medicine* 75 (1956): 7-13; earlier pioneers irradiated their own hands for test.

Holtzmann Kevles calls established interstate transmission in America of scans (e.g, Florida-California, Massachusetts-Carolina) *tele*-radiography,[501] while Jeff Goldsmith calls one sent virtually anywhere through broadband Internet connectivity *tele*-radiology.[502] The difference is never between roentgenography and radiography or radiology per se, but how far and whether it distances medical staff from or brings them physically closer to people in pain.

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[501] B. H. Kevles, *Naked to the Bone: Medical Imaging in the Twentieth Century* (Reading: Addison-Wesley, 1997), 299.

[502] J. Goldsmith, *Digital Medicine: Implications for Healthcare Leaders* (Chicago: Health Administration Press, 2003), 24.

8. 2. Centripetal diagnosis

8. 2. 1. *La méthode graphique*: phonocardiography

> No one was as successful at making visible what kept to the shadows. How were these dark areas to be lighted? The forces of life are hidden; by transposing them he brought them fully into light. […] From this, Marey would try to go further and track down the imperceptible, the fleeting, the tumultuous and the flashing. The extraordinary "image-maker" would demonstrate how one could tame what was elusive. –François Dagognet

Etienne Jules Marey pioneered kymography with the levered stylus writing on a revolving paper-taped drum: self-recording detectors were inserted by him (realizing the possibilities of externally appreciating events inside an organism) along the course of an artery to capture pulsation. This system remained a gross interest throughout Marey's life, which he replaced later with some of the earliest cinematography. Dagognet, a modern Stoic theorist of inscription (see **2. 1. 2**) illustrates how this M.D. whose degree thesis had been upon the circulation when healthy or ill also became an exponent in studying gait and flight.[503] Before that, however, Marey was responsible for agreements still effective in the standardization of electrocardiography across national barriers without changing any meanings,[504] which consisted of a silvered quartz or glass string

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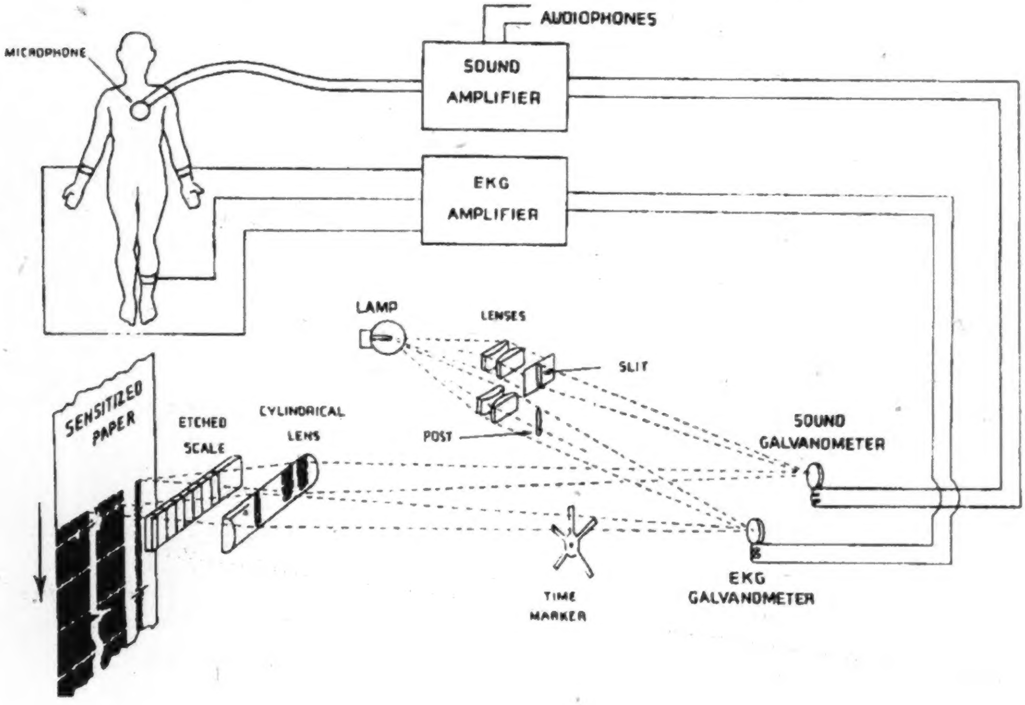
[503] F. Dagognet, *Etienne-Jules Marey: A Passion for the Trace* (New York: Urzone, 1992), 15.

[504] E. Marey, "Uniformity in Graphic Records," *Archives of Medicine* (1880): 174-77.

0.002 to 0.003 mm in thickness attached to leads from the patient; using another galvanometer, heart sounds and valvular murmurs were registered—phonocardiography.[505]

Figure 8. 2. 1-1. Phono-electrocardiographic recording[506]



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[505] L. Bull, "On the Simultaneous Record of the Phono- and Electro-cardiogram, " *Quarterly Journal of Experimental Physiology* 4 (1911): 289-92.

[506] Reprinted from *American Heart Journal*, 21, Maurice B. Rappaport and Howard B. Sprague, "Physiologic and Physical Laws That Govern Auscultation, and Their Clinical Application," 286, Copyright (1941), with permission from Elsevier; cf. E*K*G is the German acronym.

As mentioned earlier, a three-plus-one scheme underlies my entire dissertation: illness, signs, diagnosis and spatial virtualization between the latter two. Phonocardiography may likewise be narrated *pas-à-pas* as follows: heart sounds that continue, from-audio-to-visual conversion by way of electricity, shared judgement after information was dispatched long-distance.

8. 2. 1. 1. First of its triad: beat

> When I first gave my mind to vivisections, as a means of discovering the motions and uses of the heart, and sought to discover these from actual inspection, and not from the writings of others […] I could neither rightly perceive at first when the systole and when the diastole took place, nor when and where dilatation and contraction occurred, by reason of the rapidity of the motion, which in many animals is accomplished in the twinkling of an eye, coming and going like a flash of lightning; so that the systole presented itself to me now from this point, now from that; the diastole the same; and then everything was reversed.
>
> –William Harvey, *De motu cordis*[507]

Anatomical opening requires given death (i.e. autopsy) or dying fast—if not, killing as in Erasistratus and Herophilus' carnage (see **4. 2. 1**) or in Harvey's recollection above—to be observed. By contrast, pulsating sounds originate from deep inside but, when apparent on the skin,[508] they can be grasped non-invasively via a microphone. It makes contact with the body through either a 5-cm bell that utilizes air conduction in between so as to minimize extraneous interference or via firmly held pieces.[509] The precise timing of transient and internal events is finally possible with phonocardiography since its visual registration is spread out upon a kymographic tambour turning at a fixed rate.

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[507] *On the Motion of the Heart and Blood in Animals*, http://www.fordham.edu/halsall/mod/1628harvey-blood.html, Chapter I.

8. 2. 1. 2. Second: transduction

A microphone placed on the chest, being a specific type of transducer actuated by power from one source and supplying it to another system, converts heart beats into a boosted voltage which is then inscribed as one scrolling curve. Electricity merely intervenes between what is heard privately and seen together; while the aligned electrocardiogram of systoles results from a quality that we can hardly perceive (i.e. potential difference and change) just as sonography does from vibrations whose inaudible frequency oscillates upwards of 2 MHz—positively when it strikes gases or liquids which are getting nearer and negatively when these dynamically travelling fluids retreat.[510] I have assigned no thesis chapters to either of the latter two (see **4. 1**) since they—like positron emission tomography, a more representative procedure that exceptionally features in **Chapter 7** for comparison with nuclear magnetic resonance *imaging* etc.—do not *cultivate* our existing senses[511] but rather bring thitherto undetectable phenomena (e.g. magnetism, gravity) mostly before sight.

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[508] Lucretius, *Of the Nature of Things*, Book IV, http://www.gutenberg.org/dirs/etext97/natng10.txt.

[509] Morton E. Tavel, *Clinical Phonocardiography and External Pulse Recording* (Chicago: Year Book Medical Publishers, 1985), 19-20.

[510] Shigeo Satomura, "Ultrasonic Doppler Method for the Inspection of Cardiac Functions," *Journal of the Acoustical Society of America* 29 (1957): 1181-85. We could also discern haemo-reflections because they are 1000-10000 times weaker than any scatter from

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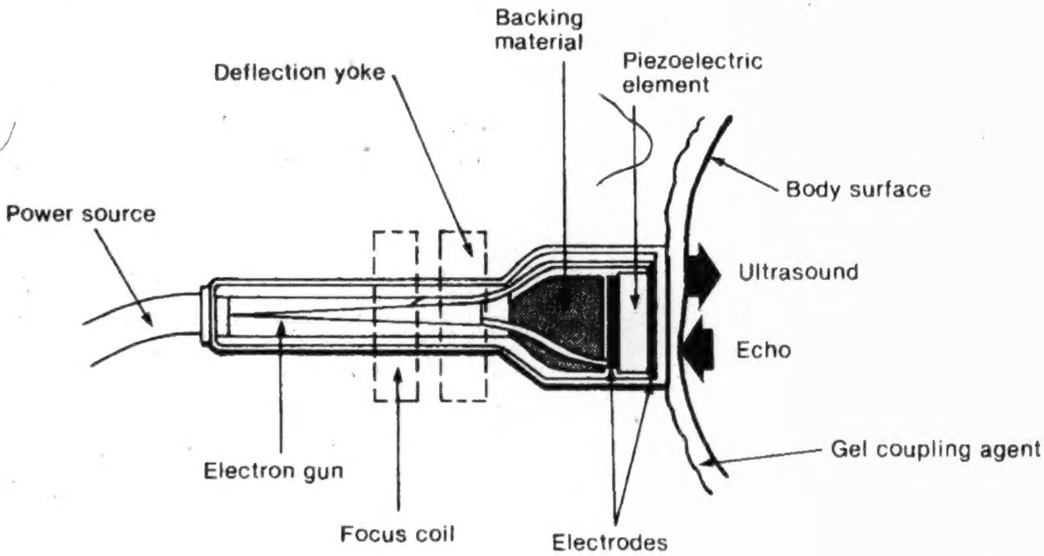
solids; Harald Becher and Peter N. Burns, *Handbook of Contrast Echocardiography: Left Ventricular Function and Myocardial Perfusion* (Berlin: Springer Verlag, 2000), 2. The reverberation inside a probe—below—filled with quartz ceramics yields data elastically to be registered on a screen; Jens U. Quistgaard, "Signal Acquisition and Processing in Medical Diagnostic Ultrasound," *IEEE Signal Processing Magazine* 14 (1997): 67-74.



Reprinted from *Introduction to Diagnostic Imaging*, I. Meschan & D. J. Ott, p. 5, © 1984, with permission from Elsevier.

[511] Merriley Borell, "Instrumentation and the Rise of Modern Physiology," *Science & Technology Studies* 5 (1987): 53-62.

8. 2. 1. 3. Third: interpretation

> It is perfectly true that by the sphygmograph we become familiar with differences and peculiarities of the pulse so minute that the most delicate and practised finger would fail to recognise them; but the difficulty lies in the fact that the record is written in a language which we are only beginning to understand. Without a proper knowledge of the physiological facts, of which they are the transcript, the oscillations of the lever are quite as meaningless as the vibrations of the telegraphic needle to one who is not furnished with a proper alphabet.

Sir John Scott Burdon-Sanderson once imported this non-invasive, though cumbersome, pulsation monitor assembled by Etienne Jules Marey to Britain[512] where few people then accepted it as practical. Ever reserved, they rightfully asked: what are the significant criteria—pattern, strength or rhythm? Can a radial sphygmometer with some weighing mechanism do more than merely substitute one's private impression with the ear and hand? It took years before clinicians like Sir Thomas Lewis, from a polygraphic background, to acquire enough training in the diagnosis of major irregularities: he saved cardiography from being a pale science but medically employed it.[513]

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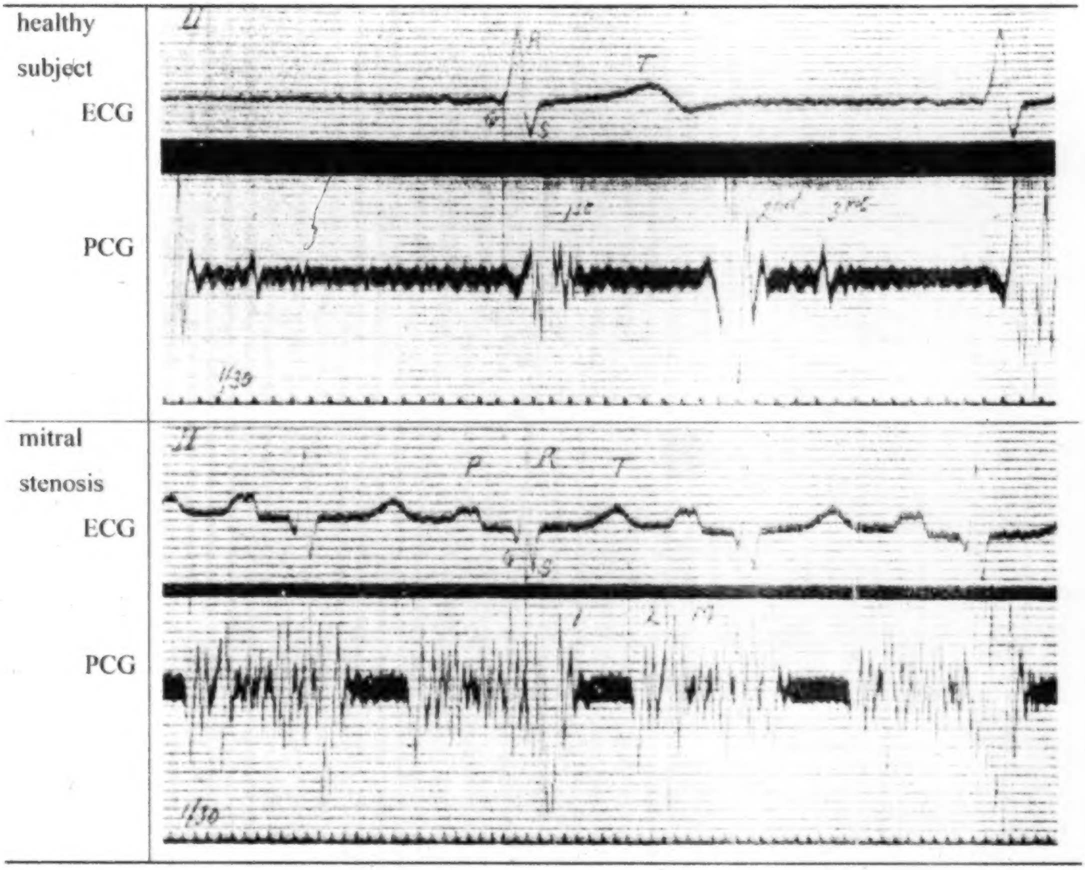
[512] J. Burdon-Sanderson, "On the Application of Physical Methods to the Exploration of the Movements of the Heart and Pulse in Disease, No. I. On the Theory of the Pulse," *Lancet* ii (November 10, 1866): 517-19.

[513] See, e.g., Joel D. Howell, "Early Perceptions of the Electrocardiogram: From Arrhythmia to Infarction," *Bulletin of the History of Medicine* 58 (1984): 83-98.

Figure 8. 2. 1. 3-1. Two pairs of electro- and phono-cardiographs[514]



Simultaneous points on each row lie along the same vertical line; almost, despite a transmission lag of 1/500 second in the latter tracing. At their bottom, time-markers are spaced 1/30 second apart from each other. A few characteristics of mitral stenosis, i.e.

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[514] Reproduced with permission, from T. Lewis, 1913, *Heart*, 4, 241-58. © the Biochemical Society.

valvular narrowing between the left ventricle and left atrium of a heart which prevents blood from streaming back,[515] are displayed on the lower pair of graphs as:

> intense and late first heart sound (*1*) with a pre-systolic accentuation before it;
> second one (*2*) showing typical splits;
> diastolic murmur (*M*) vibrating where the third sound would normally appear.

The extent of *Q-1* interval, prolonged for such a first-sound delay, and murmur at peaks of the rapid filling wave after starting a diminuendo parallels the severity of mitral stenosis. I compare PCG charts like this one with positron emission tomography's statistical mapping of the cerebral activities (see **7. 3** for more justification) since both are *diagrammatic* expressions, as maintained by Charles Sanders Peirce,[516] drawn upon a plane appropriated to each purpose so consequently we can analyse them in public.

8. 2. 1. 4. Between secondness and thirdness: wire-connected service

19th-century doctors felt no enthusiasm to communicate medical data beyond urban hospitals where they clustered until Willem Einthoven was ready to explore the clinical needs of his capillary electrometer (a visual indicator of change in potential used by Etienne Jules Marey and John Burdon-Sanderson but later discarded) or later, a more delicate string galvanometer. It needed to be connected, being large and relatively immovable, to a trio of electrodes—right hand with left one, right hand with left foot, left hand with left foot—while the subject's arms and leg were put into solution at some quiet ward in Leiden University for observations, hooked up over a telegraph line almost 1.5 km away from Einthoven's rather noisy *laboratorium*.[517]

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[515] Aldo A. Luisada and Francesco Portaluppi, *The Heart Sounds: New Facts and Their Clinical Implications* (New York: Praeger Publishers, 1982), 167-76.

Why not combine this galvanometer with the microphone? Otto Weiss and Gerhard Joachim registered heart beats mechanically by fastening one end of a silvered thread onto the centre of a sensitive bubble and joining the other end to a holder. The vibrating membrane transferred its movements to a glass lever. This movement was delivered with the aid of a battery and telephone to distant medical societies or classes in physical examination of aortic/mitral insufficiency and stenosis.[518] Further post-war experiments with this acoustic media reflected concern about the growing isolation of rural physicians from current medical centres. A result, to Einthoven's surprise however, was virtually automatic diagnosis even by non-specialists without them having met the patient, something made possible due to such graphic evidence.[519]

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[516] *Collected Papers* (Cambridge: Harvard University Press, 1931-35 & 1958), Volume IV, paragraph 430; book II of this volume is titled "existential graphs" by the editors.

[517] W. Einthoven, "Le Télécardiogramme," *Archives Internationales de Physiologie* 4 (1906-07): 132-64.

[518] O. Weiss and G. Joachim, "Registrierung und Reproduktion menschlicher Herztöne und Herzgeräusche," *Pflügers Archiv European Journal of Physiology* 123 (1908): 341-86.

[519] George E. Burch and Nicholas P. DePasquale, *A History of Electrocardiography* (San Francisco: Norman Publishing, 1990), 63-64.

8. 2. 2. Desirable telemedicine

Despite its centrifugal penchant, telemedicine brings information, not people, from home/outpatient settings (and mobile hospitals in rare disasters) to an urban medical centre. Although this debate frequently rotates around managing textual knowledge,[520] tele-radiology or -radiography has become invaluable for rural communities with no on-site reading of semeiotic images available: PC-based units communicate via ISDN lines and now have TV-quality video interfaces. Even three-dimensionally simulated environments are possible on the web.[521]

From this overview, we see two mutually opposite directions on mobilities. First, centrifugal motives have kept a physician from his or her patient: René Théophile Hyacinthe Laënnec invented the stethoscope not to immediately contact a sick girl and, may I assume, tuberculosis victims; likewise worried epidemiologically, photographers left the scene after taking pictures of smallpox cases to manually retouch them with colour paints. X-ray operators began setting themselves off from the hazard-emitting Crookes or Coolidge tube, a distance greater than employed for overdosing fluoroscopy. Secondly, centripetal imperatives have brought those once far apart closer together:

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[520] For example James E. Katz et al., "E-health Networks and Social Transformations: Expectations of Centralization, Experiences of Decentralization," in *The Network Society: A Cross-cultural Perspective*, ed. Manuel Castells (Cheltenham: Edward Elgar, 2004).

[521] Zhuming Ai and Mary Rasmussen, "Desktop and Conference Room VR for Physicians," in *Medicine Meets Virtual Reality 13: The Magical Next Becomes the Medical Now*, eds. James D. Westwood et al. (Amsterdam: IOS Press, 2005); Barrie Gunter, *Digital Health: Meeting Patient and Professional Needs Online* (Mahwah: Lawrence Erlbaum Associates, 2005).

Willem Einthoven developed a method of recording electrocardiograms at his laboratory fed one mile away from Leiden University's hospital; after telephonic stethoscopy relayed heart sounds between London and England's southern island, post-war experiments with acoustic devices reflected concern about rural isolation.

The concept of diagnosing from a distance seems therefore hardly new. Many radiological images are nowadays transmitted virtually everywhere online and wireless; however, some argue that remote *consulting* (for which, in psychiatry, talks over phone might be good enough) has developed into teleradiology.[522] In turn this has been followed by expert-programmed decision about graphic data—using advanced *form-recognition* software to eliminate some errors that human interpreters made.[523]

> One summer day in 1996, Hans Ohlin, the fifty-year-old chief of coronary care at the University of Lund Hospital in Sweden, sat down in his office with a stack of two thousand two hundred and forty electrocardiograms. Each test result consisted of a series of wavy lines, running from left to right on a letter-size page of graph paper. Ohlin read them alone in his office so that he would not be disturbed. He scanned them swiftly but carefully, one at a time, separating them into two piles according to whether or not he thought that the patient was having a heart attack at the time the electrocardiogram (EKG) was recorded. To avoid fatigue and inattention, he did his work over the course of a week, sorting through the EKGs in shifts no longer than two hours, and taking long breaks. He wanted

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[522] Richard Wootton, "Telemedicine Consultations," in *Medicine and the Internet*, ed. Bruce C. McKenzie (Oxford: Oxford University Press, 2002).

[523] Jeff Goldsmith, *Digital Medicine: Implications for Healthcare Leaders* (Chicago: Health Administration Press, 2003), 24.

> no careless errors; the stakes were too high. This was the medical world's version of the Deep Blue chess match, and Ohlin was cardiology's Gary Kasparov. He was going head to head with a computer. [...] The study was led by Lars Edenbrandt, a medical colleague of Ohlin's and an expert in artificial intelligence. Edenbrandt spent five years perfecting his system, first in Scotland and then in Sweden. He fed his computer EKGs from more than ten thousand patients, telling it which ones represented heart attacks and which ones did not, until the machine grew expert at reading even the most equivocal of EKGs. Then he approached Ohlin, one of the top cardiologists in Sweden and a man who ordinarily read as many as ten hundred thousand EKGs a year. Edenbrandt selected two thousand two hundred and forty EKGs from the hospital files to test both of them on, of which exactly half, eleven hundred and twenty, were confirmed to show heart attacks. With little fanfare, the results were published in the fall of 1997. Ohlin correctly picked up six hundred and twenty. The computer picked up seven hundred and thirty-eight. Machine beat man by 20 percent.[524]

Hence a question: which among our five senses (or six including reason) can travel electronically? Already in **Chapters 2-3** respectively, I have categorized them into *visum* at height, *gustum*/*tactum* on surface and *olfactum*/*auditum* in depth—inspired by Titus Lucretius Carus' topology—while Alanus de Insulis considered their mobility to prioritize *visum*, *auditum*, *olfactum*, *gustum* and *tactum* in hierarchical order (Figure 8. 2. 2-1). Only the first two are transmitted afar[525] during which each needs to be tamed rationally.[526] Computer algorithms like Edenbrandt's automated cardiographic reading (from simple heuristic strategies to a range of deliberate ones) intervene in clinical judgement. Yet, does this support affective care? Referencing my synthetic framework, people suffer hurtful emotions or affects when *ill*; can any medical tools help us empathize with them?[527] Particularly, radiology is not interactive in real time but store-and-forward i.e. asynchronously retrieving *signs* from the archive, which renders *diagnosticians* more comfortable than other *virtual* sub-domains.[528]

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[524] Quoted from Atul Gawande, *Complications: A Surgeon's Note on an Imperfect Science* (New York: Picador, 2002), 35-37.

[525] Sight and hearing are "those which perceive through a medium," said Aristotle, *On Sense and the Sensible*, part 5. http://pinkmonkey.com/dl/library1/gp022.pdf.

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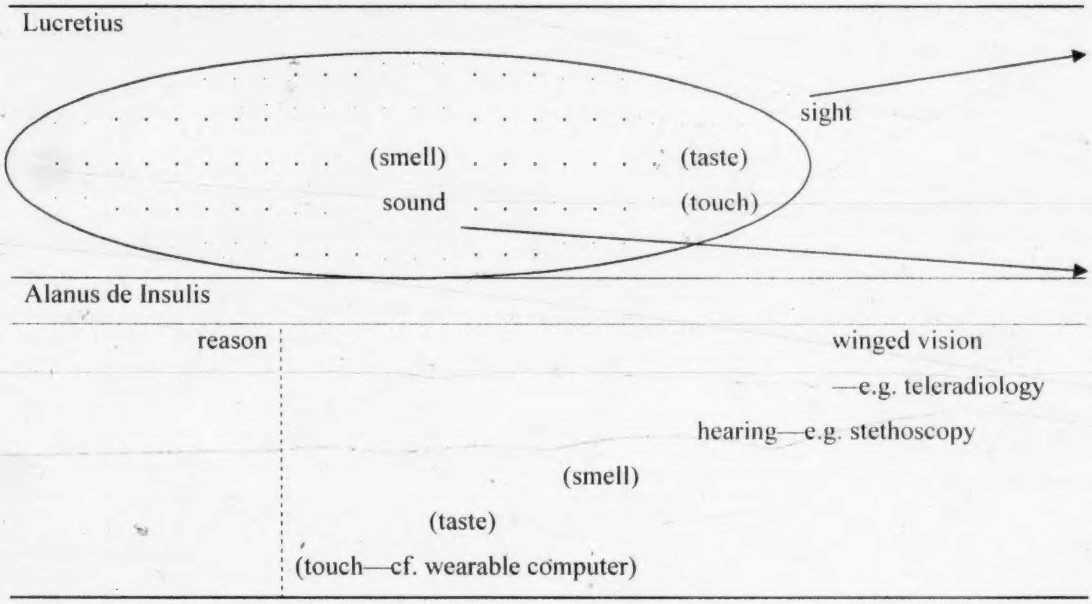
[526] See, to compare the metaphoric steeds of 13th-century symbolism, F. Mütherich, "An Illustration of the Five Senses in Mediaeval Art," *Journal of the Warburg and Courtauld Institutes* 18 (1955): 140-41; vis-à-vis Empedocles' four elements, vision flies like being *fired*, hearing gallops and smell walks both *airborne*, *watery* taste plods, touch is *earthbound*.

[527] National Initiative for Telehealth, *Framework of Guidelines* (Ottawa: Health Canada, 2003), 30-35.

[528] Yao Y. Shieh and Mason Shieh, "Teleradiology Case: Present and Future," in *E-health Care Information Systems: An Introduction for Students and Professionals*, ed. Joseph Tan (San Francisco: Jossey-Bass, 2005).

Figure 8. 2. 2-1. Mediated perception: *De rerum natura* vs. *Anticlaudianus*.



9. "That the mental faculties follow the bodily constitution"[529]

> Sorrow is lightened by the sympathy of friends. Hence the question may be raised whether friends actually share the burden of grief, or whether, without this being the case, the pain is nevertheless diminished by the pleasure of their company and by the consciousness of their sympathy. [...] But on the other hand to see another pained by our own misfortunes is painful, as everyone is reluctant to be a cause of pain to his friends.
>
> –Aristotle, *Nichomachean Ethics*[530]

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[529] Galen in *Greek Medicine: Being Extracts Illustrative of Medical Writers from Hippocrates to Galen*, ed. Arthur J. Brock (New York: AMS Press, 1972). Presented at the Canadian Semiotic Association, Toronto, May 2002; titled "James-Lange thesis applied to pain—a semiotic reappraisal." Abstract reads: While psychology (or the equivalent) of Peirce—"a sign gives birth, mediated by the emotional reaction, to the muscular and finally habitual *interpretant*"—merged later into behaviorism, that of James, his colleague—"an exciting object once elicits certain corporeal alterations, then our *feeling* of them is the emotion"—still provides both theoretical and practical implications far beyond the disciplinary mainstream with a short history. If one can, following James, distinguish such a third phase of his from the "irreducible" wholeness, the warning function of pain remains under *analgesia* (killing the former) instead of *anaesthesia* (upon the latter)—"data about injury are never unpleasant *per se*"—or of pathological indifference. Were we to find where the hurtful experience takes place (e.g. the central nervous system) as his critics have done, the hierarchical mind-body dichotomy—speaking like a Stoic, "the soul is hardly affected"—should be waiting; not the Thomist *communicatio* between the two. In the interpersonal respect, despite the seventeenth century solipsism according to which introspective *reality* as opposed to external *veridicality* counts much also to James, there is a mystical exception of *sympathy*—either resemblance or comfort from the Aristotelian tradition of ethics and rhetoric.

[530] http://www.perseus.tufts.edu, Book 9. 11. 1171a-b.

I have built this dissertation upon a triadic model where ① illness, a virtually subsisting *eventum* that happens inside the patients,[531] is ② signified through visualization and ③ diagnosed (see Figure 3. 1. 4-1). Such medical technologies evolved historically, but they have maintained three Peircian semiotic patterns: *diagram*, *index* and—to a lesser extent—*metaphor*. But what gets lost while attempting to apathetically gaze at those ailing bodies? Can we instead bear witness to and communicate linguistically about their subjective discomfort in other ways by listening to such grumble?

Most people know what is like to undergo pain; articulating verbally a thing which they feel would be, nonetheless, just another story. The International Association for the Study of Pain's official definition states, "an unpleasant sensory and *emotional* experience associated with actual or potential tissue damage,"[532] which I am willing to accept verbatim. To annotate this: first, pain would result from tissue damage; thus an unpleasant experience without tissue damage (e.g. something that stinks, but not enough to impair the olfactory receptors) and experience with tissue damage that is not unpleasant (ongoing death of cells) fall short of pain. Secondly, no one can experience my subjective-by-nature pain with/for me. The judgement *unpleasant* likewise is made introspectively—namely "as that which hurts."[533]

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[531] Alain Badiou goes beyond individual accidents with this "event" concept towards external cultural and political rarities, in *Manifesto for Philosophy* (Albany: State University of New York Press, 1999), 79-88. This is not how Gilles Deleuze read stoicism (see **2. 1. 1**).

[532] IASP Subcommittee on Taxonomy, "Pain Terms: A List with Definitions and Notes on Usage," *Pain* 6 (1979): 250; italicized by me.

When somebody is—according to Richard A. Sternbach—in pain, she or he may also have the stimulus and response thereof; yet their emotion might be more relevant to my point here[534] because, speaking narrowly, a painful stimulus comes from outside and the response is not pain itself but *to* it. Criticizing behaviourists who might designate pain as either stimulus or response like they frequently do, Carroll Ellis Izard places it "literally in between."[535] Still, to feel or evaluate—rather than be in—pain *before* emotion, George Pitcher falls back on delineating it as though it was a stimulating percept.[536] Hence the ubiquitously implied sequence of stimulus-emotion-response, whereby our body seemingly relates to mind, should be under suspicion.

They say bodily pain is an existential, salient and solipsistic phenomenon—more than pleasure maybe. Consider how Emmanuel Lévinas exaggerates repeatedly:

> While in moral pain one can preserve an attitude of dignity and compunction, and consequently already be free: physical suffering in all its degrees entails the

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[533] Vernon B. Mountcastle, *Medical Physiology* (St. Louis: The C. V. Mosby Company, 1980), 391; see also Noemi Tousignant, "Pain and the Pursuit of Objectivity: Pain-measuring Technologies in the United States, c. 1890-1975" (PhD diss., McGill University, 2006).

[534] R. A. Sternbach, *Pain: A Psychophysiological Analysis* (New York: Academic Press, 1968), 1-12.

[535] C. E. Izard, *Human Emotions* (New York: Plenum Press, 1977), 168.

[536] G. Pitcher, "The Awfulness of Pain," *Journal of Philosophy* 67 (1970): 481-92; see also Nikola Grahek, "Objective and Subjective Aspects of Pain," *Philosophical Psychology* 4 (1991): 249-66.

> impossibility of detaching oneself from the instant of existence. It is the very irremissibility of being […] there is an absence of all refuge.[537]

There is, against Levinas, retreat not to mention surgical blockage of the somatosentory pathways of pain sensation: pre-operative hypnosis, medication including placebo, acupuncture, other psycho-social treatment and electroanalgesia.[538] Is pain the human (or humanist) condition as he asserts? My answer follows: it is neither humane nor humanitarian—our endeavours to abolish it throughout history prove this. Medical ambition, moreover, pursues the exemption from somatic pain now that the biochemical era has come when such major neurotransmitters as dopamine can be artificially discharged on the basis of a triumphant and utilitarian ethics.

9. 1. From classical philosophy to empirical semiotic of pain-emotion

> The painful experience takes place in that living frame; but the perception of it belongs to the sensitive phase of the soul, which, as neighbouring the living body, feels the change and makes it known to the principle, the imaging faculty, into which the sensations finally merge; then the body feels the pain, or at least the body is affected […] and the soul feels it by an adoption due to what we think of as proximity. And, itself unaffected, it feels the corporeal conditions at every point of its being, and is thereby enabled to assign every condition to the exact

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[537] E. Lévinas, *Time and the Other* (Pittsburgh: Duquesne University Press, 1987), 69.

[538] C. Richard Chapman, "The Hurtful World: Pathological Pain and Its Control," in *Feeling and Hurting*, eds. Edward C. Carterette and Morton P. Friedman (New York: Academic Press, 1978), 284-92.

> spot at which the wound or pain occurs. Being present as a whole at every point of the body, if it were itself affected the pain would take it at every point, and it would suffer as one entire being, so that it could not know, or make known, the spot affected; it could say only that at the place of its presence there existed pain—and the place of its presence is the entire human being. –Plotinus[539]

Emotions or passions[540] feature in a few Aristotelian contexts.[541] He regarded investigations concerning animal life, for example Socrates' on pain (*λυμη*),[542] as more wonderful and constructive than other forms of inquiry. The biologist in Aristotle defined affections (*πασχειν*) not only by their cognitive form (*ειδος*) but as the underlying natural matter (*υλη*), all of which are discussed as physiological movements e.g. anger being *caused by, ended with or expressed in* a surging of the blood.[543]

Aristotle in his *Eudemian* and *Nicomachean Ethics* stated that people should avoid extremes, whether excess or deficiency, and keep a middle course. Moral virtue pertains to feelings (*παθη*) of pain; it works like medicine by opposite means—if not punishment. This is the contrary maxim to *similia similibus curantur* or homoeopathy (see **2. 2. 1**). Thus he justly praised courage attended by pain as endurance.

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[539] *The Fourth Ennead*, 4th Tractate. 19, http://ccat.sas.upenn.edu/jod/texts/plotinus

[540] *Emotion* in Algirdas Julien Greimas and Jacques Fontanille's passional lexicon is an intense disposition reacted momentarily rather than permanently, separately not continuously (both unlike *temperament* or *character*) and with the dominant modality of *pouvoir*. A. J. Greimas and J. Fontanille, *The Semiotics of Passions: From States of Affairs to States of Feeling* (Minneapolis: University of Minnesota Press, 1993), 49-52.

[541] William W. Fortenbaugh, *Aristotle on Emotion: A Contribution to Philosophical Psychology, Rhetoric, Poetics, Politics and Ethics* (London: Duckworth, 2002).

[542] Plato, *Philebus*, http://www.perseus.tufts.edu

[543] Aristotle, *On the Soul*, BOOK I, Part 1, http://classics.mit.edu/Aristotle/soul.html

In the second book of *Rhetoric* and *Poetics*, he paid attention to listeners' emotion (*παθος*) roused by the orator's persuasive speech. Passions signify interpersonal differences in opinion: individuals communicate by universally recognizing their own *and* others' diverse—if not opposite—passions. These also, paradoxically, manifest differences *within* our divided identity.[544] The Parisian school of semiotics (see **7. 3. 2**) is language-oriented in this way; while Algirdas Julien Greimas and Jacques Fontanille refer to Spinozian ethics, they assume the somatism of a subject too: "what affects the mind can affect the body, and [...] the affecting of the body can become a passional spectacle for the mind."[545]

Such a corporeal element is lacking when Charles Sanders Peirce describes wonder as a sign of inference, arising while one conjectures under complex situations beyond our understanding.[546] However, in a publication titled "Some Consequences of Four Incapacities" [1868], Peirce exhibited a series according to which, preceded by the thought-sign (*that abominable thing*), an emotion (*I'm angry*) causes strong commotions in one's body (*strike*).[547] Elsewhere, among his several definitions of *interpretant*, a nonmentalist version reads "the explicit outcome of a sign or of the object it represents." This definition is augmented by three kinds: an emotional *interpretant* agitates its energetic one as the latter—repeated via either muscular or inward exertions—would result in a further modification of personal habits i.e. a logical *interpretant* transiently or permanently in the conditional future.[548]

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[544] Michel Meyer, *Philosophy and the Passions: Toward a History of Human Nature* (University Park: Pennsylvania State University Press, 2000).

[545] Greimas and Fontanille, 59.

[546] Although nerves are involved herewith; C. S. Peirce, *Collected Papers* (Cambridge: Harvard University Press, 1931-35 & 1958), Volume II, paragraphs 643 (citation is to *CP* Volume. paragraph).

[547] http://www.peirce.org/writings/p27.html

So much has been written on how Peirce managed to advance from the Plato-Lockean *σημειωτικη* of ethereal *idea*; but did Peirce go too far? It may comparatively be easy now to renounce Charles Morris' claim for unambiguous science where *sign-behaviours* need testing by observation. However, we should not deny that he was an heir of the "realist" doctrine of *interpretant*—crystallized as one's disposition to respond overtly.[549] Hence epistemologically, the line between American semioticians (i.e. Morris and Peirce) appears not always convincing to me. With pragmati*c*ism since 1905, Peirce became stuck in *common-sense* more than ever[550] such as the stimulus-organism-response psychology; James, a physician by training which is shown in his philosophy, inverted the two latter terms: stimulus-response-organism.

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[548] *CP* V. 473 ff; I found another triad in a few letters dated 1909 to William James (immediate, dynamical, ultimate or final *interpretants*) which looks incompatible with the aforementioned version: *CP* VIII. 314-15.

[549] C. W. Morris, *Writings on the General Theory of Signs* (The Hague: Mouton, 1971), 19-21 & 103-6.

[550] *CP* VI. 480.

9. 2. "We don't tremble because we *are* fearful; we *feel* afraid because we tremble"[551]

I shall never admit that you [pain] are an evil. –Posidonius of Apamea[552]

Levis est dolor. –Lucius Annaeus Seneca, Jr. (4 B.C. ~ 65 A.D.)[553]

William James considered the standard [1884; originally "What Is an Emotion?" in *Mind*] or later *coarser* emotions which accompany some physical movements, but excluded subtle aesthetical ones. Was this a déjà-vu of body-mind dualism? It does not merely teach how important those responses are; our commonly held view is that one perceives certain events like pain, which induce mental states to produce reaction in turn. This sort of *functionalist* psychology focuses upon the observable stimulus-response causation where subjectivity falls into the invisible middle—i.e. organism. When this syllogistic order was reversed, we could turn to a 19th-century hypothesis: "the bodily changes follow directly the perception of the exciting fact, and […] our feeling *of* the same changes as they occur is the emotion"[554] that comes after such corporeal alterations. Emotion needs those internal signs-to-be-felt or habitual *interpretants* representing a veridically apprehended object.

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[551] William James conceptualized *feeling* differently from how Charles Sanders Peirce did as firstness e.g. *redness* in one's mind independently of anything else (see **2. 2. 2 & 3**); James's—unlike *being*—has an object "standing for pleasure and pain" in *The Principles of Psychology*, 185-87, http://psychclassics.yorku.ca/James/Principles/index.htm

[552] Quoted in Marcus Tullius Cicero, *Tusculan disputations II* (Warminster: Aris & Phillips, 1990), 61; see also Richard Sorabji, *Emotion and Peace of Mind: From Stoic Agitation to Christian Temptation* (Oxford: Oxford University Press, 2002), 27.

[553] "It will soon cease." *Ad Lucilium epistulae morales* (London: William Heinemann Ltd, 1962-67), Letter LXXVIII.

Table 9. 2-1. James-Lange [1885] theory of emotion[555]

① stimulus

sensed in the cerebral cortex ⇓

② response

autonomic nervous system	reflexes e.g. sweating
endocrine glands	secretion of hormones
adrenal medulla	(nor)epinephrine/steroid
voluntary muscles	coping behaviours
viscera	e.g. heart-beating

feedback to the amygdala ⇓

③ emotion

John Dewey, while depreciating James' idea (*a bear*)-discharge (bodily disturbances)-excitation (fright) semiotics, incorporated *habit* into a defence of James who in person had not much done so. The organized tendency precedes a reverberating

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[554] James, 449; italicized by me.

[555] CHAPTER XXV in James' *Principles of Psychology* [1890] adds, onto the *Mind* article, what he discovered afterwards in Carl Georg Lange from Denmark; see also C. G. Lange, "The Emotions: A Psychophysiological Study," in *The Emotions*, ed. Knight Dunlap (New York: Hafner Publishing Company, 1967), 33-90.

affect.[556] Empirical tests have also supported this controversial thesis: when 25 patients with spinal lesions at 5 levels (cervical, thoracic 1-4, 7-12, lumbar and sacral vertebrae; listed from central to peripheral) were subjected to structured interviews, the results showed—the higher the wound, the greater the reduction in some emotions since the sensory input derives from the less portion of a body although the responses may be displayed in the same way as before they got injured.[557]

May we subtract feelings, James asked, from the full experience of emotion? Paradoxically, acute pain serves to warn the individual's central nervous system that his or her body has sustained something that requires attention. This is how one gets protection from everyday dangers in given surroundings—with such a constructive role of aptly deleted but still "unpleasant" pain. Pathological cases of congenital indifference to pain are reported among children before 3. They seldom cry due to blows, falls, cuts, bruises or even fractures of the bones or third degree burns. Some patients correctly identify any stimulus that would cause other normal people experimental pain; yet make no complaint. Even though some of them can live with numerous wounds into middle age, this lack of sensation is maladaptive.[558]

Impromptu, some might say there are bad kinds of pain (e.g. chronic one) and others, strangely good kinds; however, supposing that its benefits can be separated from negative emotions, we do not have to balance them—harmful or helpful—according to each situation. Is this possible? Anaesthesia signifies *no sensation* either locally (the corresponding part becoming numb) or generally (even consciousness vanishing). On the other hand, analgesia gives rise to loss of the emotional dimension only, leaving the signal.[559]

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[556] J. Dewey, "The Theory of Emotion (II): The Significance of Emotions," *Psychological Review* 2 (1895): 13-32.

[557] George W. Hohmann, "Some Effects of Spinal Cord Lesions on Experienced Emotional Feelings," *Psychophysiology* 3 (1966): 143-56.

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[558] Frank Rodolph Ford, *Diseases of the Nervous System in Infancy, Childhood and Adolescence* (Springfield: Charles C Thomas Publishers, 1973), 137-41.

[559] Alfred Feingold, M.D., attempts to show online visitors many embellished impressions of healing procedures; yet *Image of Surgery* ends up documenting paternalistic authoritarianism in medicine. This professional ideology appears widespread among practitioners, rather than it merely being the case that his camera/computer-job has managed to reveal (or failed to cover) it. Feingold's website (imageofsurgery.com) exhibits, first, how surgeons act in such a drama at the operating "theatre" while nurses with anaesthesiologists play "supporting" parts—to quote our doctor *cum* portraitist. Their audience, he says, are neither those students in late 19th-century paintings by Adalbert Franz Seligmann and Thomas Eakins featured thereon nor us but the subjects made indifferent to sensation—unlike during analgesia—including their warning and not-*per-se*-hurtful awareness of pain. Secondly, a collection of pictures is curated on the history page, going from those by artists e.g. Diego Rivera (*Clinic of Dr. Jean Louis Fauvre*, 1920), Henri de Toulouse-Lautrec (*Dr. Pean Operating*, 1891) and so forth to Hindu and Egyptian antiquity. Once back then, patients were at least responsive medical counterparts of their surgeons; now they have become impersonalized—or invisible. This is arguably the very image of modern doctor-patient relationship: those handling a scalpel exercise their power over the sick body unable to voluntarily cope with pain but instead laid upon a cold table—comfortably *numb* (in Greek, *an-aisthes*). Feingold might know all too well this ethical issue when he dyes a surgeon's eyes devilish red in the grid *à la* Andy Warhol who passed away suddenly following a regular gall bladder surgery. Doctors are expectedly fallible; still, we should ask whether the artist's hospital-phobia was cared for with respect. This site indeed turns out to give an *Image of Surgery* ironically, perhaps against its webmaster's intention though.

Studies into the surgical removal of pain tracts next to one's somatosensory pathway such as fibres connecting the parietal with frontal lobe and limbic system (more precisely, orbitofrontal cortex) suggest this interesting possibility in a similar manner. Patients could post-operatively tell many qualities e.g. how intensive the employed stimulus was; surprisingly they neither bellyache nor care about it. The lobotomy does not alter pain sensation, but it alleviates its bothersome emotion.[560] Such tolerance is not only a fictional cyborg standard but also real for an ideal(ized) body, harder deep inside the human-like surface and, those with a segregating mechanism are much less vulnerable to pain: "I sense injuries. The data [not unpleasant] could be called pain" (Arnold Schwarzenegger in *Terminator 2: Judgment Day*).[561] The apathetic data of pain-

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[560] Walter Freeman and James W. Watts, "Pain Mechanisms and the Frontal Lobes: A Study of Prefrontal Lobotomy for Intractable Pain," *Annals of Internal Medicine* 28 (1948): 747-54.

[561] Samantha Holland, "Descartes Goes to Hollywood: Mind, Body and Gender in Contemporary Cyborg Cinema," in *Cyberspace/Cyberbodies/Cyberpunk: Cultures of Technological Embodiment*, eds. Mike Featherstone and Roger Burrows (London: Sage Publications, 1995), 162-64; although her categorization is somewhat crude e.g. in Marge Piercy's *Body of Glass* [1991] cyborgs include Shira with retinal implants, computer interface built into her skull and corneal time-reader; Malkah, scientist with subcutaneous monitoring of blood pressure, many dentures and prosthetic eyes; Avram, fake-hearted male scientist; Gadi, artificial-kidneyed; but not Yod, purely created. Yes to *RoboCop* that is rehabilitated from the body of a mortally wounded policeman and *Tetsuo*—cybercult Ironman directed by Shinya Tsukamoto—with metallic fragments piercing out his whole skin; no to *Alien*'s heroine (Sigourney Weaver) at the second episode's final battle scene who merely put on the heavy loader as bulky as her foe; diverse bodies we meet in the last instalment such as born-of-the-blood replicant (again Weaver) and pale android (Winona Ryder); "replicant" fugitives in *Blade Runner* that are true androids fabricated with no biological components; and *Terminator*, if not robot.

Stimulus are processed to commence further cybernetic first aid. Neither stress Response nor pain-Emotion, which one might live better off without,[562] is required.

Table 9. 2-2. James-Lange scheme of pain

① pain-S	hazardous
	⇓
② pain-R	
stress e.g. peptic ulcer	even fatal
evasive reaction	*informative*
	⇓ or analgesic blockage e.g. lobotomy
③ pain-E	"unpleasant"

Could the hurtful phase (③ above) be discerned from such a whole (①/②/③), its alarming role lingers under analgesia upon that final affect[563] instead of anaesthesia killing S/R/E totally. Electrical substitution for the emotional channel dates from antiquity.[564] This method of pain relief develops to be clinically practised on chronic patients at the level of periaqueductal gray matter. Those good PGM-interfaced cyborgs use a switcher outside their body to moderate the quantity of natural opium.[565] Are these subjects what they used to be, without side effects, but having their central nervous system wired surgically? The problem of the social irresponsibility that such "ice pick" lobotomized people sometimes obtain[566] raises another question: *where* does our identity take place? Walter B. Cannon answered based on the anatomical chart: the subcortical thalamus and the ensemble of brain structures like the hippocampus.[567] Andrew C. Papanicolaou condemned him for considering the incarnated *soul* a.k.a. CNS as being a unique trigger of human phenomena.[568] Pain experience has no spatial co-ordinate: damaged cells do not feel anything; signals can be controlled in the gradual course of transmission; and nothing like a *pain* (or *emotion*) *centre* exists in the cerebrum.[569]

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[562] Michael Stocker with Elizabeth Hegeman, *Valuing Emotions* (Cambridge: Cambridge University Press, 1996), 230.

[563] Brian Massumi juxtaposes Gilles Deleuze's take on Benedictus de Spinoza with James' radical empiricism in *Parables for the Virtual: Movement, Affect, Sensation* (Durham: Duke University Press, 2002).

[564] José Manuel Rodríguez Delgado, *Physical Control of the Mind: Toward a Psychocivilized Society* (London: Harper & Row, 1971), 177-228. Au contraire, transcutaneous electrical nerve stimulation is performed around the wound; see Victoria Frampton et al., *Pain Management by Physical Therapy* (Oxford: Butterworth-Heinemann, 1994), 115-39.

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[565] K. Kumar et al., "Deep Brain Stimulation for Control of Intractable Pain in Humans, Present and Future: A Ten-year Follow-up," *Neurosurgery* 26 (1990): 774-82.

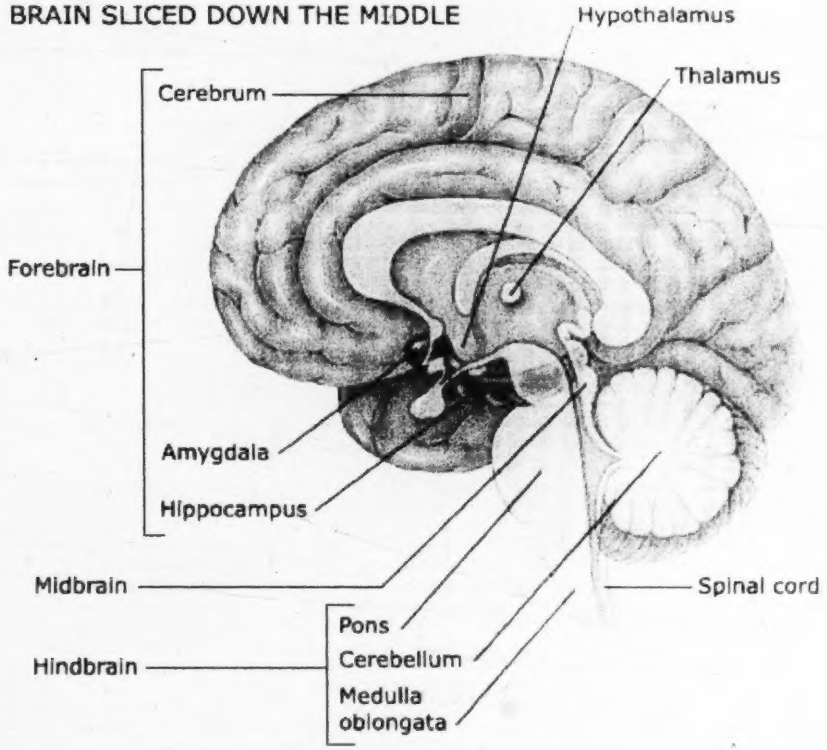
[566] Elliot S. Valenstein, *Great and Desperate Cures: The Rise and Decline of Psychosurgery and Other Radical Treatments for Mental Illness* (New York: Basic Books, 1986).

[567] W. B. Cannon, "The James-Lange Theory of Emotion: A Critical Examination and an Alternative Theory," *American Journal of Psychology* 39 (1927): 106-24.

[568] A. C. Papanicolaou, *Emotion: A Reconsideration of the Somatic Theory* (New York: Gordon and Breach, 1989), 17-22. He reads New England pragmatist James and French metaphysician—or physicist—Henri Bergson between whom there used to be such brilliant intellectual connections.

[569] Andrew William Diamond and S. W. Coniam, *The Management of Chronic Pain* (Oxford: Oxford University Press, 1997), 7-13; James, 472-74. On phantom limbs, refer to Ambroise Paré, *Oeuvres completes, t. II* (Paris: J.-B. Baillière, 1840), 212-32.

Figure 9. 2-1. Main areas of the human brain[570]



9. 3. Visual and linguistic communication (2)—in diagnostics vs. of pain

It has been this long disorder alone that has prevented my profiting of your company at Strawberry, according to the leave you gave me of asking it. I have lived upon the road between that place and this, never settled there, and uncertain whether I should go to Bath or abroad. Yesterday se'nnight I grew exceedingly ill indeed, with what they say has been the gout in my stomach, bowels, back, and kidneys. –Horace Walpole, Esq., "Letter to the Rev. Mr. Cole," 1766[571]

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[570] Lydia Kibiuk, copyright © 2003, http://www.sfn.org/skins/main/images/interactivebrain/index.html

Solipsists for example David Hume or John Locke deemed one's impressions as private and isolated by impermeable walls; *passions* (of which bodily pains—originated from objects applied to external organs—are one source; more violent than *emotions*) get transmitted. For rationalists, they are the sensory break; with Hume, these passions return as the consciousness of not only self but others![572] In relation to this old puzzle, he surmised: "No quality of human nature is more remarkable [...] than that propensity we have to sympathize with others, and to receive by *communication* their inclinations and sentiments, however different from, or even contrary to our own."[573] As the above epigraph asks, do people together alleviate pain or add to it? A sociologically informed analysis is thus warranted. Is compassion helpful or harmful, we shall ultimately ask? Saint Thomas Aquinas concluded that weeping diminishes pain.[574] It should not, if one sobbed due to sorrow; the James-Lange seriality of *affect following behaviour* via feedback[575] strengthens our scholastic Q & A master's induction of a presumed causality.

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[571] http://www.fullbooks.com/The-Letters-of-Horace-Walpole-Volumex795715.html

[572] Michel Meyer, *Philosophy and the Passions: Toward a History of Human Nature* (University Park: Pennsylvania State University Press, 2000), 175.

[573] D. Hume, *A Treatise of Human Nature*, http://socserv2.mcmaster.ca/~econ/ugcm/3ll3/hume/treat.html, Book II. PART I (italicized by me).

[574] Sorrow (*tristitia*), resulting from intellect or imagination, belongs to pain (*dolor*) by exterior/physical and interior/mental perception both; or vice versa—sorrow is attributed to any senses and have more objects while pain arises from bodily touch, only through which the subject gets injured. Thomas Aquinas sounded like a stoic materialist (see **2. 1**) in *Summa Theologiæ* (London: Blackfriars, 1968-75), 1a2æ.

Are words themselves a better courier for such traumatic messages as Walpole's than the medical imaging of morbidity e.g. x-rays, positron emission tomography and nuclear magnetic resonance scanning? Many curious analgesic cases were already linked to aphemia or, at least, anatomical difficulties with speech such as a "lesion near Wernicke's region."[576] Apparently something goes missing while, if ever possible, inadequately bringing the pre-verbal body to any specific form of discourse[577] or even memoirs written by certain literary patients.[578] Linda C. Garro analyzes how two care-seekers, facing the "ontological assault" of emporomandibular joint ache, restructured their life stories: one, before computerized axial tomography was given to identify this malady in her jaw, felt like a pest to her dentist "because I would continue to inquire why the treatment was not just rolling right along." The other, whom even neurologists failed, could not understand "why I had to give up everything but yet nothing was wrong with me. It was like you wanted to shake them and say, *Can't you see what's happening to*

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[575] William James, *The Principles of Psychology*, 450, http://psychclassics.yorku.ca/James/Principles/index.htm

[576] Paul Schilder and Erwin Stengel, "Asymbolia for Pain," *Archives of Neurology and Psychiatry* 25 (1931): 598-600.

[577] Using analogies (*my pain feels like* ...) or cries rather; Christian Heath, "Pain Talk: The Expression of Suffering in the Medical Consultation," *Social Psychology Quarterly* 52 (1989): 113-25.

[578] Lisa Diedrich, *Treatment: Language, Politics, and the Culture of Illness* (Minneapolis: University of Minnesota Press, 2007).

me?" until alternative therapy helped.[579] It therefore is hardly one particular mode of communication simply replacing others, I would argue, but doctors interpreting each symptom and sign creatively: beyond pseudo-substantively conceived *diseases* (see **3. 1. 1**) towards an empathetic prognosis.

9. 4. Epilogue

> Finally, to hinder the description of illness in literature, there is the poverty of the language. English, which can express the thoughts of Hamlet and the tragedy of Lear, has no words for the shiver and the headache. [...] let a sufferer try to describe a pain in his head to a doctor and language at once runs dry. There is nothing ready made for him. He is forced to coin words himself, and, taking his pain in one hand, and a lump of pure sound in the other (as perhaps the people of Babel did in the beginning), so to crush them together that a brand new word in the end drops out. Probably it will be something laughable. –Virginia Woolf[580]

Following the introduction to my entire dissertation, two perspectives were covered: a non-hierarchical reading by modern European thinkers of Lucretian epistemology *De rerum natura* comparing the five senses (or six including reason); and semeiotics, an old branch to which current theories of signification can be traced back.[581] The biblio- or biographical list ranges from Hippocrates to Anglophone empirico-pragmatists and French structuralists like Algirdas Julien Greimas' *école de Paris* et al.

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[579] L. Garro, "Chronic Illness and the Construction of Narratives," in *Pain as Human Experience: An Anthropological Perspective*, eds. Mary-Jo DelVecchio Good et al. (Berkeley: University of California Press, 1992).

[580] *On Being Ill* (London: The Hogarth Press, 1930), 12-13.

I brought forward a three-plus-one platform: when (1) illness has occurred, medical technology detaches (2) symptoms or signs—to either see, taste and feel on the surface or smell and hear from within—off somebody who suffers. Then for (3) diagnosis, they are virtualized spatially i.e. sent along to her or his doctor whose tasks comprise problem solving and decision making over a small number of sources for treatment. Visualization has consistently strengthened this cognitive process. Dedicated to Charles Sanders Peirce is **Chapter 4** where I have chosen three kinds of sign—*index*, *diagram* and *metaphor*—adapted from his trichotomous classification related to its object. My semi-deductive (or "abductive" to use his term) comparisons of imaging modalities from photo and x-rays to computerized axial/positron emission tomography, nuclear magnetic resonance are justified there.

In the late 19th century, Hermann Wilhelm Vogel observed mortal *indices* on the portrait of a *Frau* before she was found to have contracted pox. This prognostic shortwave emulsion remained unknown to diagnosticians and got replaced by hand-tinted photography. Retouching per se was hardly new in scientific representation; just because significations are viable only "in some capacity" does not mean that every instance of synecdoche is equal. We should thus inquire as for what aspects to pick out of corporeality—either its texture or colours.

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[581] Two other disciplines in this *ex post facto* trivium are linguistics and philosophy; see Eugene Baer, "The Medical Symptom: Phylogeny and Ontogeny," *American Journal of Semiotics* 1, No. 3 (1982): 17-34.

Aroused by Wilhelm Conrad Roentgen's discovery, Thomas Alva Edison attempted to penetrate the living skull and David Starr Jordan to capture ideas upon a "psychic retina." Both are more than hoaxes since, without people's wishful expectation, Jordan e.g. could not have validated his investigation; Erkki Huhtamo et al.'s Foucauldian media archaeology should apply here. Getting back to semiotics, computed tomographs resemble our skeleton while magnetic resonance scans imitate the soft tissue. Anne Beaulieu's contribution explains how positron emission tomography, while consumed like pictures by a lay audience, maps the brain functions quantitatively. Her accounts can be rewritten: comprised of spots, PET measures where and how many isotopes have been concentrated *diagrammatically*, fulfilling some conditions for resemblance to a decreasing extent but against the myth that *pure icons* would mimic perfectly no matter what they denote.

I have asked in the last (but not least) two chapters a key normative question: how is human suffering rendered, or lost, amidst the signs? We know about two different orientations in long-distance health care: to either isolate even non-contagious patients from their physicians (dating back to stethoscopy) or promote virtual encounters among both parties located far away from each other. This guides me to a future project topic: I can hardly make nuclear magnetic resonance imaging any less expensive but might instead argue for its traditionally diagnostic cases; however the uses of positron emission tomography (and functional MRI too) are undergoing such an expansion outside medicine as neuro-economics, an emerging area within management science that aims to view the *in vivo* anatomy of behavioural psychology. My next, post-doctoral research will be ethical reflection on cerebral (and beyond) scanning of painful emotions, potentially self-portraying, rather than consumerist brain spots—if there is any.

Bibliography

Aaron, Richard I., and Jocelyn Gibb, eds. *An Early Draft of Locke's Essay: Together with Excerpts from His Journals*. Oxford: Clarendon Press, 1936.

Ackerknecht, Erwin H. *Medicine at the Paris Hospital, 1794-1848*. Baltimore: Johns Hopkins Press, 1967.

Acland, Charles R. *Residual Media*. Minneapolis: University of Minnesota Press, 2007.

Adams, Francis, trans. *The Genuine Works of Hippocrates, v. 1*. London: Sydenham Society, 1849.

Ai, Zhuming, and Mary Rasmussen. "Desktop and Conference Room VR for Physicians." In *Medicine Meets Virtual Reality 13: The Magical Next Becomes the Medical Now*. Edited by James D. Westwood et al. Amsterdam: IOS Press, 2005.

Alan of Lille. *Anticlaudianus or the Good and Perfect Man*. Toronto: Pontifical Institute of Mediaeval Studies, 1973.

Amsterdamska, Olga, and Anja Hiddinga. "The Analyzed Body." In *Medicine in the Twentieth Century*. Edited by Roger Cooter and John Pickstone. Singapore: Harwood Academic Publishers, 2000.

Arbus, Diane. *Diane Arbus*. Millerton: Aperture, 1972.

Ardran, G. M. "The Society and X-ray Protection." *Radiography* 37 (1971): 157-65.

Aristotle. *Corpus*.

Arnold, C. R. et al. *Applied Photography*. London: Focal Press, 1971.

Auenbrugger, Leopold. *Inventum novum*. London: Dawsons of Pall Mall, 1966.

Augustine, St. *City of God*. http://www.ccel.org/ccel/schaff/npnf102.pdf

Badiou, Alain. *Manifesto for Philosophy*. Albany: State University of New York Press, 1999.

Baer, Eugene. "The Medical Symptom: Phylogeny and Ontogeny." *American Journal of Semiotics* 1, No. 3 (1982): 17-34.

Barley, Stephen R. "Technology as an Occasion for Structuring: Evidence from Observations of CT Scanners and the Social Order of Radiology Departments." *Administrative Science Quarterly* 31 (1986): 78-108.

Barrett, William F. *On the Threshold of the Unseen: An Examination of the Phenomena of Spiritualism and of the Evidence for Survival after Death*. London: Kegan Paul, Trench, Trubner & Co., 1917.

Barthes, Roland. *Œuvres complètes*. Paris: Éditions du Seuil, 2002 (citation is to *ŒC Tome. Livre*/"Texte"/"Entretien").

Bayle, Gaspard Laurent. *Recherches sur la phthisie pulmonaire*. Paris: Gabon, 1810.

Beaulieu, Anne. "Images Are Not the (Only) Truth: Brain Mapping, Visual Knowledge, and Iconoclasm." *Science, Technology, & Human Values* 27 (2002): 53-86.

Becher, Harald, and Peter N. Burns. *Handbook of Contrast Echocardiography: Left Ventricular Function and Myocardial Perfusion*. Berlin: Springer Verlag, 2000.

Behbehani, Abbas Meshkat. *The Smallpox Story: In Words and Pictures*. Kansas City: The University of Kansas Medical Center, 1988.

Bekkering, D. H. "Biomedical Engineering: Looking Back Over Twenty Years." *Medical Progress Through Technology* 7 (1980): 69-80.

Benjamin, Walter. *Gesammelte Schriften*. Frankfurt am Main: Suhrkamp Verlag, 1972-90 (citation is to *GS Band*. "Titel").

Benveniste, Émile. *Problems in General Linguistics*. Coral Gables: University of Miami Press, 1971.

Berengario da Carpi, Jacopo. *A Short Introduction to Anatomy*. Chicago: University of Chicago Press, 1959.

Bergson, Henri. *Oeuvres*. Paris: Presses Universitaires des France, 1970.

Bichat, Marie François Xavier. *Traité des membranes en général et de diverses membranes en particulier*. Paris: Méquignon-Marvis, 1827.

Bijker, Wiebe E., and John Law. *Shaping Technology/Building Society*. Cambridge: The MIT Press, 1992.

Blacklow, Robert S. "The Study of Symptoms." In *MacBryde's Signs and Symptoms: Applied Pathologic Physiology and Clinical Interpretation*. Philadelphia: Lippincott, 1983.

Blaufox, Morton Donald. *An Ear to the Chest: Evolution of the Stethoscope*. London: The Parthenon Publishing Group, 2002.

Blizzard, Deborah. "Situating Fetoscopy within Medical Literature and Lived Experience: An Opening for Social Analysis." In *Bodies of Technology: Women's Involvement with Reproductive Medicine*. Edited by Ann Rudinow Saetnan et al. Columbus: Ohio State University Press, 2000.

Borell, Merriley. "Instrumentation and the Rise of Modern Physiology." Science & Technology *Studies* 5 (1987): 53-62.

Bottéro, Jean. "La Magie et la médecine règnent à Babylone." In *Les Maladies ont une histoire*. Edited by Jacques Le Goff and Jean-Charles Sournia. Paris: L'Histoire/Seuil, 1985.

Bradley, William, and Heather Tosteson. "Basic Physics of NMR." In *Nuclear Magnetic Resonance Imaging in Medicine*. Edited by Leon Kaufman et al. New York: Igaku-Shoin, 1982.

Brewster, David. *The Stereoscope: Its History, Theory, and Construction*. Hastings-on-Hudson: Morgan & Morgan, 1971.

Brier, Søren. "What is a Possible Ontological and Epistemological Framework for a True Universal 'Information Science'? The Suggestion of a Cybersemiotics." In *The Quest for a Unified Theory of Information: Proceedings of the Second International Conference on the Foundations of Information Science*. Edited by Wolfgang Hofkirchner. Amsterdam: Gordon & Breach Publishers, 1999.

Brock, Arthur J., ed. *Greek Medicine: Being Extracts Illustrative of Medical Writers from Hippocrates to Galen*. New York: AMS Press, 1972.

Bull, L. "On the Simultaneous Record of the Phono- and Electro-cardiogram." *Quarterly Journal of Experimental Physiology* 4 (1911): 289-92.

Burch, George E., and Nicholas P. DePasquale. *A History of Electrocardiography*. San Francisco: Norman Publishing, 1990.

Burdon-Sanderson, John Scott. "On the Application of Physical Methods to the Exploration of the Movements of the Heart and Pulse in Disease, No. I. On the Theory of the Pulse." *Lancet* ii (November 10, 1866): 517-19.

Burks, Arthur W. "Icon, Index, and Symbol." *Philosophical and Phenomenological Research* IX (1949): 673-89.

Cadava, Eduardo. *Words of Light: Theses on the Photography of History*. Princeton: Princeton University Press, 1997.

Callahan, Daniel, ed. *The Role of Complementary and Alternative Medicine: Accommodating Pluralism*. Washington: Georgetown University Press, 2002.

Canguilhem, Georges. *The Normal and the Pathological*. New York: Zone Books, 1991.

Cannon, Walter B. "The James-Lange Theory of Emotion: A Critical Examination and an Alternative Theory." *American Journal of Psychology* 39 (1927): 106-24.

Cantor, David, ed., *Reinventing Hippocrates*. Aldershot: Ashgate, 2002.

Carlsson, Sten. "A Glance at the History of Nuclear Medicine." *Acta Oncologica* 34 (1995): 1095-102.

Cartwright, Lisa. "'Experiments of Destruction': Cinematic Inscriptions of Physiology." *Representations* 40 (1992): 129-52.

Celsus, Aulus Cornelius. *De medicina*. Birmingham: Classics of Medicine Library, 1989.

Chapman, C. Richard. "The Hurtful World: Pathological Pain and Its Control." In *Feeling and Hurting*. Edited by Edward C. Carterette and Morton P. Friedman. New York: Academic Press, 1978.

Chéroux, Clément. *The Perfect Medium: Photography and the Occult*. New Haven: Yale University Press, 2005.

Chevalier, Jacques M. *The 3-D Mind, v. 3—Scorpions and the Anatomy of Time*. Montreal: McGill-Queen's University Press, 2002.

Cicero, Marcus Tullius. *Tusculan disputations II*. Warminster: Aris & Phillips, 1990.

Coates, James. *Photographing the Invisible: Practical Studies in Spirit Photography, Spirit Portraiture, and Other Rare but Allied Phenomena*. New York: Arno Press, 1973.

Collins, Harry M., and Robert Evans. "The Third Wave of Science Studies: Studies of Expertise and Experience." *Social Studies of Science* 32 (2002): 235-96.

Comte, Auguste M. F. X. *The Positive Philosophy*. http://socserv2.mcmaster.ca/~econ/ugcm/3ll3/comte/Philosophy2.pdf

Cooley, Robert N., and Melvyn H. Schreiber. *Radiology of the Heart and Great Vessels*. Baltimore: Williams and Wilkins, 1978.

Cope, Zachary. *William Cheselden, 1688-1752*. Edinburgh: E. & S. Livingstone, 1953.

Corner, George W., ed. *Anatomical Texts of the Earlier Middle Ages: A Study in the Transmission of Culture*. New York: AMS Press, 1977.

Coquet, Jean-Claude. *Le Discours et son sujet 1. Essai de grammaire modale*. Paris: Klincksieck, 1984.

Corlett, William Thomas. *A Treatise on the Acute, Infectious Exanthemata: Including Variola, Rubeola, Scarlatina, Rubella, Varicella, and Vaccina, with Especial Reference to Diagnosis and Treatment*. Philadelphia: F. A. Davis Company, 1902.

Corvisart des Marets, Jean Nicholas. *An Essay on the Organic Diseases and Lesions of the Heart and Great Vessels*. Birmingham: The Classics of Medicine Library, 1984.

Coulter, Harris L. *Divided Legacy: A History of the Schism in Medical Thought, v. I. The Patterns Emerge: Hippocrates to Paracelsus.* Washington: Wehawken Book, 1975.

Courtés, Joseph. *Introduction à la sémiotique narrative et discursive: Méthodologie et application*. Paris: Hachette, 1976.

Crookes, William. *Researches in the Phenomena of Spiritualism.* Manchester: Two Worlds Publishing Company, 1926.

Crookshank, Francis G. "The Importance of a Theory of Signs and a Critique of Language in the Study of Medicine." In *The Meaning of Meaning: A Study of the Influence of Language upon Thought and of the Science of Symbolism.* By Charles K. Ogden and Ivor Armstrong Richards. London: Routledge & Kegan Paul, 1989.

Crosby, Alfred W. "Smallpox." In *The Cambridge Historical Dictionary of Disease*. Edited by Kenneth F. Kiple. Cambridge: Cambridge University Press, 2003.

Cunningham, Andrew. *The Anatomical Renaissance: The Resurrection of the Anatomical Projects of the Ancients.* Aldershot: Ashgate, 2003.

Dagognet, François. *Etienne-Jules Marey: A Passion for the Trace*. New York: Urzone, 1992.

Damadian, R. "Tumor Detection by Nuclear Magnetic Resonance." *Science* 171 (1971): 1151-53.

Danesi, Marcel. *Giambattista Vico and the Cognitive Science Enterprise*. New York: P. Lang, 1995.

de Beaugrande, Robert-Alain, and Wolfgang Urlich Dressler. *Introduction to Text Linguistics*. London: Longman, 1981.

de Ketham, Johannes. *Fasciculus medicinae*. Birmingham: The Classics of Medicine Library, 1988.

De Lacy, Phillip. "Galen's Platonism." *American Journal of Philology* 93 (1972): 27-39.

de Saussure, Ferdinand. *Course in General Linguistics*. New York: Philosophical Library, 1959.

De Schepper, A. M. et al. "Magnetic Resonance Imaging of Soft Tissue Tumors." *European Radiology* 10 (2000): 213-22.

Debray, Régis. *Vie et mort de l'image: Une Histoire du regard en Occident*. Paris: Éditions Gallimard, 1992.

Deleuze, Gilles. *The Logic of Sense*. New York: Columbia University Press, 1990.

Deleuze, Gilles, and Félix Guattari. *A Thousand Plateaus: Capitalism and Schizophrenia*. Minneapolis: University of Minnesota Press, 1987.

Delgado , José Manuel Rodríguez. *Physical Control of the Mind: Toward a Psychocivilized Society*. London: Harper & Row, 1971.

Derrida, Jacques. *Of Grammatology*. Baltimore: The Johns Hopkins University Press, 1976.

Derrida, Jacques, and Bernard Stiegler. *Echographies of Television: Filmed Interviews*. Cambridge: Polity, 2002.

Dewey, John. "The Theory of Emotion (II): The Significance of Emotions." *Psychological Review* 2 (1895): 13-32.

Dewhurst, Kenneth. "Locke and Sydenham on the Teaching of Anatomy." *Medical History* 2 (1958): 1-12.

di Chiro, Giovanni. "Brain Imaging of Glucose Utilization in Cerebral Tumors." In *Brain Imaging and Brain Function*. Edited by Louis Sokoloff. New York: Raven Press, 1985.

Diamond, Andrew William, and S. W. Coniam. *The Management of Chronic Pain*. Oxford: Oxford University Press, 1997.

Didi-Huberman, Georges. *Invention of Hysteria: Charcot and the Photographic Iconography of the Salpêtrière*. Cambridge: The MIT Press, 2003.

Diedrich, Lisa. *Treatment: Language, Politics, and the Culture of Illness*. Minneapolis: University of Minnesota Press, 2007.

Diogenes Laertius. *Lives of Eminent Philosophers*. London: William Heinemann Ltd., 1965-66.

Donné, Alfred. "Images photogéniques d'objets microscopiques." *Comptes Rendus Hebdomadaires des Séance* 10 (1840): 339.

Dorland, W. A. Newman. *The American Illustrated Medical Dictionary*. Philadelphia: W.B. Saunders & Co., 1942.

Doyle, Arthur Conan. *The History of Spiritualism*. New York: Arno Press, 1975.

Dubois, Philippe. *L'Acte photographique et autres essais*. Paris: Éditions Nathan, 1990.

Duffin, Jacalyn. *To See with a Better Eye: A Life of R.T.H. Laennec*. Princeton: Princeton University Press, 1998.

Duke, Martin. *The Development of Medical Techniques and Treatments: From Leeches to Heart Surgery*. Madison: International Universities Press, 1991.

Dumit, Joseph. *Picturing Personhood: Brain Scans and Biomedical Identity*. Princeton: Princeton University Press, 2004.

Dunlap, Knight, ed. *The Emotions*. New York: Hafner Publishing Company, 1967.

Dziabis, Lisa. "Glimpses of the Body's Interior." *Caduceus* 1 (1985): 42-50.

Eco, Umberto. *Semiotics and the Philosophy of Language*. New York: The Macmillan Press, 1984.

Eco, Umberto, and Thomas A. Sebeok. *The Sign of Three: Dupin, Holmes, Peirce*. Bloomington: Indiana University Press, 1983.

Edelstein, Ludwig. *Ancient Medicine*. Baltimore: The Johns Hopkins Press, 1967.

Eder, Josef Maria. *History of Photography*. New York: Dover Publications, 1978.

Einthoven, Willem. "Le Télécardiogramme." *Archives Internationales de Physiologie* 4 (1906-07): 132-64.

Eisenbud, Jule. *The World of Ted Serios: "Thoughtographic" Studies of an Extraordinary Mind*. New York: William Morrow & Company, 1967.

Elstein, Arthur S. et al. *Medical Problem Solving: An Analysis of Clinical Reasoning*. Cambridge: Harvard University Press, 1978.

Ernst, Waltraud, ed. *Plural Medicine, Tradition and Modernity, 1800-2000*. London: Routledge, 2002.

Ewald, François. Foreword to "Désir et plaisir," by Gilles Deleuze, *Magazine Littéraire* 325 (1994): 57-65.

Featherstone, Mike et al. *The Body: Social Process and Cultural Theory*. London: Sage, 1993.

Fernel, Jean. *On the Hidden Causes of Things: Forms, Souls and Occult Diseases in Renaissance Medicine*. Leiden: Brill, 2005.

Fleming, Peter R. *A Short History of Cardiology*. Amsterdam: Rodopi, 1997.

Flusser, Vilém. *Towards a Philosophy of Photography*. London: Reaktion Books, 2000.

Forbes, John. Foreword to *A Treatise on the Diseases of the Chest: In Which They Are Described According to Their Anatomical Characters, and Their Diagnosis Established on a New Principle by Means of Acoustick Instruments, with Plates*, by René Théophile Hyacinthe Laennec. London: T. and G. Underwood, 1821.

Ford, Frank Rodolph. *Diseases of the Nervous System in Infancy, Childhood and Adolescence*. Springfield: Charles C Thomas Publishers, 1973.

Fortenbaugh, William W. *Aristotle on Emotion: A Contribution to Philosophical Psychology, Rhetoric, Poetics, Politics and Ethics*. London: Duckworth, 2002.

Foucault, Michel. *The Birth of the Clinic: An Archaeology of Medical Perception*. New York: Pantheon Books, 1973.

Fowler, J. S. et al. "A Shielded Synthesis System for Production of 2-Deoxy-2-[^{18}F]fluoro-D-Glucose." *Journal of Nuclear Medicine* 22 (1981): 376-80.

Fox, George Henry. *A Practical Treatise on Small-pox*. Lippincott, Philadelphia, 1902.

Frampton, Victoria et al. *Pain Management by Physical Therapy*. Oxford: Butterworth-Heinemann, 1994.

Fraprie, Frank R., and Walter E. Woodbury. *Photographic Amusements: Including Tricks and Unusual or Novel Effects Obtainable with the Camera*. New York: Arno Press, 1973.

Fraser, James D., and David R. Anderson. "Venous Protocols, Techniques, and Interpretations of the Upper and Lower extremities." *Radiologic Clinics of North America* 42 (2004): 279-96.

Freeman, Walter, and James W. Watts. "Pain Mechanisms and the Frontal Lobes: A Study of Prefrontal Lobotomy for Intractable Pain." *Annals of Internal Medicine* 28 (1948): 747-54.

Freud, Sigmund. *The Standard Edition of the Complete Psychological Works of Sigmund Freud, v. XV: Introductory Lectures on Psycho-analysis*. London: The Hogarth Press, 1961.

Fuchs, Arthur W. "Evolution of Roentgen Film." *American Journal of Roentgenology, Radium Therapy and Nuclear Medicine* 75 (1956): 30-48.

Fyfe, Gordon, and John Law. *Picturing Power: Visual Depiction and Social Relations*. London: Routledge, 1988.

Galen, Claudius. *Corpus*.

Galison, Peter. *Image & Logic: A Material Culture of Microphysics*. Chicago: University of Chicago Press, 1997.

Garcia Ballester, Luis. "Galen as a Medical Practitioner: Problems in Diagnosis." In *Galen: Problems and Prospects*. Edited by Vivian Nutton. London: Wellcome Institute for the History of Medicine, 1981.

Garrison, Fielding H., and Edward C. Streeter. "Sculpture and Painting as Modes of Anatomical Illustration." In *History and Bibliography of Anatomical Illustration*. By Ludwig Choulant. New York: Hafner Publishing Company, 1962.

Garro, Linda C. "Chronic Illness and the Construction of Narratives." In *Pain as Human Experience: An Anthropological Perspective*. Edited by Mary-Jo DelVecchio Good et al. Berkeley: University of California Press, 1992.

Gaudillière, Jean-Paul. *Inventer la biomédecine: La France, l'Amérique et la production des savoirs du vivant, 1945-1965*. Paris: Éditions La Découverte, 2002.

Gawande, Atul. *Complications: A Surgeon's Note on an Imperfect Science*. New York: Picador, 2002.

Genot, Gérard. *Elements of Narrativics: Grammar in Narrative, Narrative in Grammar*. Hamburg: Buske, 1979.

Gernsheim, Alison. "Medical Photography in the Nineteenth Century." *Medical & Biological Illustration* 11 (1961): 85-92 & 147-56.

Gibson, Henry Louis. *Medical Photography; Clinical-ultraviolet-infrared*. Rochester: Eastman Kodak Company, 1973.

Gilman, Sander L. *Disease and Representation: Images of Illness from Madness to AIDS*. Ithaca: Cornell University Press, 1988.

Gilson, Erinn. "Questioning to the Nth Power: Interrogative Ontology in Merleau-Ponty and Deleuze." *Chiasmi International* 6 (2005): 207-24.

Gitelman, Lisa. *Always Already New: Media, History, and the Data of Culture*. Cambridge: The MIT Press, 2006.

Glasser, Otto. "Technical Development of Radiology: 1906-1956." *American Journal of Roentgenology, Radium Therapy and Nuclear Medicine* 75 (1956): 7-13.

Goldsmith, Jeff. *Digital Medicine: Implications for Healthcare Leaders*. Chicago: Health Administration Press, 2003.

Grahek, Nikola. "Objective and Subjective Aspects of Pain." *Philosophical Psychology* 4 (1991): 249-66.

Grau, Oliver. *MediaArtHistories*. Cambridge: The MIT Press, 2007.

Greimas, Algirdas Julien. *On Meaning: Selected Writings in Semiotic Theory*. Markham: Fitzhenry & Whiteside Limited, 1987.

Greimas, Algirdas Julien, and Jacques Fontanille. *The Semiotics of Passions: From States of Affairs to States of Feeling*. Minneapolis: University of Minnesota Press, 1993.

Greimas, Algirdas Julien, and Joseph Courtés. *Semiotics and Language: An Analytical Dictionary*. Bloomington: Indiana University Press, 1982.

Griffiths, A. Phillips, ed. *Contemporary French Philosophy*. Cambridge: Cambridge University Press, 1987.

Grigg, Emanuel R. N. *The Trail of the Invisible Light: From X-Strahlen to Radio-(bio)logy.* Springfield: Charles C Thomas, 1965.

Gross, Alan G. "The Brains in *Brain*: The Co-evolution of Localization and Its Images." *Journal of the History of the Neurosciences* (special issue on visual images and visualization; forthcoming).

Groupe μ. *Traité du signe visuel: Pour une Rhétorique de l'image.* Paris: Éditions du Seuil, 1992.

Grove, Allen W. "Röntgen's Ghosts: Photography, X-rays, and the Victorian Imagination." *Literature and Medicine* 16 (1997): 141-73.

Gubern, Román. "From Optical to Digital: When the Same is Different." *Visio* 4 (1999): 55-60.

Gumbrecht, Hans Ulrich, and Karl Ludwig Pfeiffer, eds. *Materialities of Communication.* Stanford: Stanford University Press, 1994.

Gunning, Tom. "Phantom Images and Modern Manifestations: Spirit Photography, Magic Theater, Trick Films, and Photography's Uncanny." In *Fugitive Images: From Photography to Video.* Edited by Patrice Petro. Bloomington: Indiana University Press, 1995.

Gunter, Barrie. *Digital Health: Meeting Patient and Professional Needs Online.* Mahwah: Lawrence Erlbaum Associates, 2005.

Hahn, Robert A. *Sickness and Healing: An Anthropological Perspective.* New Haven: Yale University Press, 1995.

Harrison, Mark. *Disease and the Modern World: 1500 to the Present Day.* Cambridge: Polity, 2004.

Hartog, François. *The Mirror of Herodotus: The Representation of the Other in the Writing of History.* Berkeley: University of California Press, 1988.

Harvey, William. *Exercitatio anatomica de motu cordis et sanguinis in animalibus.* http://www.fordham.edu/halsall/mod/1628harvey-blood.html

Heath, Christian. "Pain Talk: The Expression of Suffering in the Medical Consultation." *Social Psychology Quarterly* 52 (1989): 113-25.

Heidegger, Martin. *The Question Concerning Technology and Other Essays.* New York: Harper and Row, 1977.

Hénault, Anne. *Histoire de la sémiotique.* Paris: Presses Universitaires de France, 1992.

Herodotus. *The Histories.* http://www.perseus.tufts.edu

Hevesy, George, and F. A. Paneth. *A Manual of Radioactivity*. London: Oxford University Press, 1938.

Higson, G. R. "The Beginning of CT Scanning—A Personal Recollection." *Bulletin of the British Institute of Radiology* 5 (1979): 3-4.

Hippocrates. *Corpus*.

Hjelmslev, Louis. *Prolegomena to a Theory of Language*. Madison: The University of Wisconsin Press, 1961.

Hoffmeyer, Jesper. *Signs of Meaning in the Universe*. Bloomington: Indiana University Press, 1996.

Hohmann, George W. "Some Effects of Spinal Cord Lesions on Experienced Emotional Feelings." *Psychophysiology* 3 (1966): 143-56.

Holland, Samantha. "Descartes Goes to Hollywood: Mind, Body and Gender in Contemporary Cyborg Cinema." In *Cyberspace/Cyberbodies/Cyberpunk: Cultures of Technological Embodiment*. Edited by Mike Featherstone and Roger Burrows. London: Sage Publications, 1995.

Hook, Ernest B., ed. *Prematurity in Scientific Discovery: On Resistance and Neglect*. Berkeley: University of California Press, 2002.

Hooke, Robert. *The Posthumous Works*. London: Sam. Smith and Benj. Walford, 1705.

Hounsfield, Godfrey Newbold. "Historical Notes on Computerized Axial Tomography." *Journal of the Canadian Association of Radiologists* 27 (1976): 135-42.

Howell, Joel D. "Early Perceptions of the Electrocardiogram: From Arrhythmia to Infarction." *Bulletin of the History of Medicine* 58 (1984): 83-98.

Hudson, Robert P. "Concepts of Disease in the West." In *The Cambridge World History of Human Disease*. Edited by Kenneth F. Kiple. Cambridge: Cambridge University Press, 2003.

Huhtamo, Erkki. "From Kaleidoscomaniac to Cybernerd: Notes toward an Archeology of Media." In *Electronic Culture: Technology and Visual Representation*. Edited by Timothy Druckrey. New York: Aperture, 1996.

Hume, David. *A Treatise of Human Nature*. http://socserv2.mcmaster.ca/~econ/ugcm/3ll3/hume/treat.html

Hunter, William. *The Anatomy of the Human Gravid Uterus Exhibited in Figures*. Birmingham: Classics of Medicine Library, 1980.

Hüsing, Bärbel et al. *Impact Assessment of Neuroimaging: Final Report of the Centre for Technology Assessment*. Zurich: vdf, 2006.

IASP Subcommittee on Taxonomy. "Pain Terms: A List with Definitions and Notes on Usage." *Pain* 6 (1979): 249-52.

Ihde, Don. *Technics and Praxis*. Dordrecht: D. Reidel Publishing Company, 1979.

Izard, Carroll Ellis. *Human Emotions*. New York: Plenum Press, 1977.

Jackson, Jean. "Chronic Pain and the Tension between the Body as Subject and Object." In *Embodiment and Experience: The Existential Ground of Culture and Self*. Edited by Thomas J. Csordas. Cambridge: University of Cambridge Press, 1994.

Jakobson, Roman. *Language in Literature*. Cambridge: Belknap Press, 1987.

James, William. *The Principles of Psychology*. http://psychclassics.yorku.ca/James/Principles/index.htm

Johnson, Jim. "Mixing Humans and Nonhumans Together: The Sociology of a Door-closer." In *Ecologies of Knowledge: Work and Politics in Science and Technology*. Edited by Susan Leigh Star. Albany: State University of New York Press, 1995.

Johnston, John, ed. *Literature, Media, Information Systems*, by Friedrich A. Kittler. Amsterdam: G+B Arts International, 1997.

Jordan, David Starr. "The Sympsychograph: A Study in Impressionist Physics." *Appleton's Popular Science Monthly* 49 (1896): 597-602.

Jordanova, Ludmilla. *Sexual Visions: Images of Gender in Science and Medicine between the Eighteenth and Twentieth Centuries*. Madison: The University of Wisconson Press, 1989.

Jouanna, Jacques. *Hippocrates*. Baltimore: The Johns Hopkins University Press, 1999.

Katz, James E. et al. "E-health Networks and Social Transformations: Expectations of Centralization, Experiences of Decentralization." In *The Network Society: A Cross-cultural Perspective*. Edited by Manuel Castells. Cheltenham: Edward Elgar, 2004.

Kember, Sarah. *Virtual Anxiety: Photography, New Technologies and Subjectivity*. Manchester: Manchester University Press, 1998.

Kemp, Martin. *Visualizations: The* Nature *Book of Art and Science*. Oxford: Oxford University Press, 2000.

Kevles, Bettyann Holtzmann. *Naked to the Bone: Medical Imaging in the Twentieth Century*. Reading: Addison-Wesley, 1997.

King, Lester S. *Medical Thinking: A Historical Preface*. Princeton: Princeton University Press, 1982.

Kittler, Friedrich A. "A Discourse on Discourse." *Stanford Literature Review* 3 (1986): 157-66.

Kleinman, Arthur. *Writing at the Margin: Discourse between Anthropology and Medicine*. Berkeley: University of California Press, 1995.

Knight, Nancy. "'The New Light': X Rays and Medical Futurism." In *Imagining Tomorrow: History, Technology, and the American Future*. Edited by Joseph J. Corn. Cambridge: The MIT Press, 1986.

Knorr, Karin D. et al., eds. *The Social Process of Scientific Investigation*. Dordrecht: D. Reidel Publishing Company, 1980-81.

Koyré, Alexandre. *Newtonian Studies*. London: Chapman & Hall, 1965.

Kracauer, Siegfried. *The Mass Ornament: Weimar Essays*. Cambridge: Harvard University Press, 1995.

Kremkau, Frederick W. *Diagnostic Ultrasound: Principles and Instruments*. St. Louis: Saunders Elsevier, 2006.

Kress, Gunther, and Theo van Leeuwen. *Reading Images: The Grammar of Visual Design*. London: Routledge, 1996.

Kristeva, Julia. *La Révolution du langage poétique*. Paris: Éditions du Seuil, 1974.

Kuklick, Henrika, and Elizabeth Long, eds. *Knowledge and Society: Studies in the Sociology of Culture Past and Present, Volume 6*. Greenwich: JAI Press Inc, 1986.

Kumar, K. et al. "Deep Brain Stimulation for Control of Intractable Pain in Humans, Present and Future: A Ten-year Follow-up." *Neurosurgery* 26 (1990): 774-82.

Laënnec, René Théophile-Hyacinthe. *A Treatise on the Diseases of the Chest*. New York: Haftner Publishing Company, 1979.

Lain Entralgo, P. *Doctor and Patient*. New York: McGraw-Hill Book Company, 1969.

Lange, Fritz M., and D. Meltzing. "Die Photographie des Mageninnern." *Münchener Medicinische Wochenschrift* 45 (1898): 1585-88.

Latour, Bruno. *Pandora's Hope: Essays on the Reality of Science Studies*. Cambridge: Harvard University Press, 1999.

Latour, Bruno, and Steve Woolgar. *Laboratory Life*. Beverly Hills: Sage Publications, 1979; Princeton: Princeton University Press, 1986.

Lauterbur, Paul C. "Image Formation by Induced Local Interactions: Examples Employing Nuclear Magnetic Resonance." *Nature* 242 (1973): 190-91

Law, John, and John Hassard, eds. *Actor Network Theory and After*. Oxford: Blackwell Publishers, 1999.

Lawlor, Clark. *Consumption and Literature: The Making of the Romantic Disease*. New York: Palgrave Macmillan, 2007.

Lenoir, Timothy. "Was the Last Turn the Right Turn? The Semiotic Turn and A. J. Greimas." *Configurations* 2 (1994): 119-36.

Leonardo da Vinci. *Leonardo on the Human Body*. New York: Dover Publications, 1983.

Lévinas, Emmanuel. *Time and the Other*. Pittsburgh: Duquesne University Press, 1987.

Levin-Rozalis, Miri. "Searching for the Unknowable: A Process of Detection—Abductive Research Generated by Projective Techniques." *International Journal of Qualitative Methods* 3, no. 2 (2004): 1-36.

Lévy, Pierre. *Becoming Virtual: Reality in the Digital Age*. New York: Plenum Trade, 1998.

Lewis, Thomas. "The time relations of heart sounds and murmurs, with special reference to the acoustic signs in mitral stenosis." *Heart* 4 (1913): 241-58.

Lindekens, René. *Essai de sémiotique visuelle—Le photographique, le filmique, le graphique*. Paris, Éditions Klincksieck, 1976.

Littré, Émile, trans. *Oeuvres complètes d'Hippocrate, v. I-X*. Amsterdam: Adolf M. Hakkert, 1973-82.

Lock, Margaret et al. *Living and Working with the New Medical Technologies: Intersections of Inquiry*. Cambridge: Cambirdge University Press, 2000.

Locke. John. *An Essay Concerning Human Understanding*. http://www.ilt.columbia.edu/publications/locke_understanding.html

Lotringer, Sylvère, and Paul Virilio. *The Accident of Art*. New York: Semiotext(e), 2005.

Lucretius Carus, Titus. *Of the Nature of Things*. http://www.gutenberg.org/dirs/etext97/natng10.txt

Luisada, Aldo A., and Francesco Portaluppi. *The Heart Sounds: New Facts and Their Clinical Implications*. New York: Praeger Publishers, 1982.

Lunnon, Ray J. "Clinical Ultraviolet Photography." *Journal of the Biological Photographic Association* 36, no. 2 (1968): 72-78.

Lupton, Deborah. *Medicine as Culture: Illness, Disease and the Body in Western Societies*. London: Sage, 2003.

Lynch, Michael. "The Externalized Retina: Selection and Mathematization in the Visual Documentation of Objects in the Life Sciences." *Human Studies* 11 (1988): 201-34.

Mac Orlan, Pierre. "Preface to *Atget photographe de Paris*." In *Photography in the Modern Era: European Documents and Critical Writings, 1913-1940*. Edited by Christopher Phillips. New York: The Metropolitan Museum of Art, 1989.

Mackenzie, Donald. *Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance*. Cambridge: The MIT Press, 2000.

Maehle, Andreas-Holger. "The Search for Objective Communication: Medical Photography in the Nineteenth Century." In *Non-verbal Communication in Science Prior to 1900*. Edited by Renato G. Mazzolini. Firenze: Leo S. Olschki, 1993.

Mangione, Salvatore, and Steven J. Peitzman, "Physical Diagnosis in the 1990s: Art or Artifact." *Journal of General Internal Medicine* 11 (1996): 490-93.

Mansfield, P., and P. G. Morris. *NMR Imaging in Biomedicine: Supplement 2. Advances in Magnetic Resonance*. New York: Academic Press, 1982.

Marchessault, Janine, and Kim Sawchuk. *Wild Science: Reading Feminism, Medicine and the Media*. London: Routledge, 2000.

Marey, Etienne Jules. "Uniformity in Graphic Records." *Archives of Medicine* (1880): 174-77.

Marmo, Costantino. "Definition and Classification of Signs in XIIIth and XIVth Century Medicine." *RS·SI* 18, no. 3-19, no. 1 (1998-99): 25-37.

Martin, Emily. "The End of the Body?" *American Ethnologist* 19 (1992): 121-40.

Marx, Karl. "*Differenz der demokritischen und epikureischen Naturphilosophie*." Ph.D. diss., Universität Jena, 1841.

Massumi, Brian. *Parables for the Virtual: Movement, Affect, Sensation*. Durham: Duke University Press, 2002.

Medical Imaging Technology Roadmap Steering Committee. *Report of Working Group 3: Transmission and Connectivity*. Ottawa: Industry Canada, 2001.

Melzack, R. "Phantom Limbs." *Scientific American* 266, no. 4 (1992): 90-96.

Melzack, R., and W. S. Torgerson. "On the Language of Pain." *Anaesthesiology* 34 (1971): 50-59.

Merleau-Ponty, Maurice. *Phenomenology of Perception*. London: Routledge & Kegan Paul, 1962.

Meschan, I., and D. J. Ott. *Introduction to Diagnostic Imaging*. Philadelphia: W.B. Saunders Company, 1984.

Metz, Christian. "Photography and Fetish." In *OverExposed: Essays on Contemporary Photography*. Edited by Carol Squiers. New York: The New Press, 1999.

Meyer, Michel. *Philosophy and the Passions: Toward a History of Human Nature*. University Park: Pennsylvania State University Press, 2000.

Mill, John Stuart. *A System of Logic: Ratiocinative and Inductive*. London: Longman, Green, and Co., 1906.

Mintz, David. "What's in a Word: The Distancing Function of Language in Medicine." *Journal of Medical Humanities* 13 (1992): 223-33.

Mitchell, Lisa Meryn. *Baby's First Picture: Ultrasound and the Politics of Fetal Subjects*. Toronto: University of Toronto Press, 2001.

Moan, Johan. "Visible Light and UV Radiation." In *Radiation at Home, Outdoors and in the Workplace*. Edited by Dag Brune et al. Oslo: Scandinavian Science Publisher, 2001.

Moles, Abraham. "Pour une révision du serment d'Hippocrate: Vers une nouvelle dimension sociale du contrat medical." *Prospective et Sante* 12 (1979): 9-18.

Morgagni, Giovanni Battista. *The Seats and Causes of Diseases Investigated by Anatomy*. Birmingham: Classics of Medicine Library, 1983.

Morris, Charles W. *Writings on the General Theory of Signs*. The Hague: Mouton, 1971.

Mountcastle, Vernon B. *Medical Physiology*. St. Louis: The C. V. Mosby Company, 1980.

Mütherich, F. "An Illustration of the Five Senses in Mediaeval Art." *Journal of the Warburg and Courtauld Institutes* 18 (1955): 140-41.

Nadar, Felix. "My Life as a Photographer." *October* 5 (1978): 6-28.

National Initiative for Telehealth. *Framework of Guidelines*. Ottawa: Health Canada, 2003.

Newton, Isaac. *Opticks or a Treatise of the Reflections, Refractions, Inflections & Colours of Light*. New York: Dover Publications, 1952.

Nietzsche, Friedrich Wilhelm. *The Gay Science; With a Prelude in Rhymes and an Appendix of Songs*. New York: Vintage Books, 1974.

Oppenheim, Janet. *The Other World: Spiritualism and Psychical Research in England, 1850-1914*. Cambridge: Cambridge University Press, 1985.

Paans, A. M. J. et al. "A Comparison of the Sensitivity of PET and NMR for In Vivo Quantitative Metabolic Imaging." *European Journal of Nuclear Medicine* 11 (1985): 73-75.

Packard, Francis R., trans. *Guy Patin and the Medical Profession in Paris in the XVIIth Century*. New York: A. M. Kelley, 1970.

Papanicolaou, Andrew C. *Emotion: A Reconsideration of the Somatic Theory*. New York: Gordon and Breach, 1989.

Paré, Ambroise. *Oeuvres completes, t. II*. Paris: J.-B. Baillière, 1840.

Parssinen, Terry M. "Professional Deviants and the History of Medicine: Medical Mesmerists in Victorian Britain." In *On the Margins of Science: The Social Construction of Rejected Knowledge*. Edited by Roy Wallis. Keele: University of Keele, 1979.

Pasveer, Bernike. "Knowledge of Shadows: The Introduction of X-ray Images in Medicine." *Sociology of Health & Illness* 11 (1989): 360-81.

Patin, G. *Lettres 1630-1672*. Paris: Librairie Honoré Champion, 1907.

Peirce, Charles Sanders. *Collected Papers*. Cambridge: Harvard University Press, 1931-35 & 1958 (citation is to *CP* Volume. paragraph).

Pelc, Jerzy. "Iconicity: Iconic Signs or Iconic Uses of Signs?" In *Iconicity: Essays on the Nature of Culture*. Edited by Paul Bouissac et al. Tübingen: Stauffenburg, 1986.

Penfield, Wilder, and Theodore Rasmussen. *The Cerebral Cortex of Man: A Clinical Study of Localization of Function*. New York: The Macmillan Company, 1955.

Permutt, Cyril. *Beyond the Spectrum: A Survey of Supernatural Photography*. Cambridge: Patrick Stephens, 1983.

Perron, Paul, and Frank Collins, eds. *Paris School Semiotics II. Practice*. Amsterdam: John Benjamins Pub., 1989.

Persaud, T. V. N. *Early History of Human Anatomy: From Antiquity to the Beginning of the Modern Era*. Springfield: Charles C Thomas, 1984.

Peters, John Durham. "John Locke, the Individual, and the Origin of Communication." *Quarterly Journal of Speech* 75 (1989): 387-99.

Petrilli, Susan, and Augusto Ponzio. *Semiotics Unbounded: Interpretive Routes through the Open Network of Signs*. Toronto: University of Toronto Press, 2005.

Pickering, George White. *Hypertension: Causes, Consequences and Management*. Edinburgh: Churchill Livingstone, 1974.

Piorry, Pierre Adolphe. *De la Percussion médiate et des signes obtenus à l'aide de ce nouveau moyen d'exploration dans les maladies des organes thoraciques et abdominaux*. Paris: J. S. Chaude, 1828.

Pitcher, George. "The Awfulness of Pain." *Journal of Philosophy* 67 (1970): 481-92.

Plato. *Corpus*.

Plotinus. *The Fourth Ennead*. http://ccat.sas.upenn.edu/jod/texts/plotinus

Polhemus, Ted. *The Body Reader: Social Aspects of the Human Body*. New York: Pantheon, 1978.

Polunin, Ivan. "The Body as an Indicator of Health and Disease." In *The Anthropology of the Body*. Edited by John Blacking. London: Academic Press, 1977.

Postman, Neil. *Technopoly: The Surrender of Culture to Technology*. New York: Alfred A. Knopf, 1992.

Potter, Paul. *Short Handbook of Hippocratic Medicine*. Québec: Les Éditions du Sphinx, 1988.

Prince, Gerald. *A Dictionary of Narratology*. Lincoln: University of Nebraska Press, 2003.

Proctor, Robert N., and Londa Schiebinger. *Agnotology: The Making and Unmaking of Ignorance*. Stanford: Stanford University Press, 2008.

Propp, Vladimir. *Morphology of the Folktale*. Austin: University of Texas Press, 1984.

Proust, Marcel. *Remembrance of Things Past, v. 3*. New York: Random House, 1981.

Putnam, Samuel, and William B. Stiles. "Verbal Exchanges in Medical Interviews: Implications and Innovations." *Social Science & Medicine* 36 (1993): 1597-1604.

Quistgaard, Jens U. "Signal Acquisition and Processing in Medical Diagnostic Ultrasound." *IEEE Signal Processing Magazine* 14 (1997): 67-74.

Rappaport, Maurice B., and Howard B. Sprague. "Physiologic and Physical Laws That Govern Auscultation, and Their Clinical Application." *American Heart Journal* 21 (1941): 257-318.

Rastier, François et al. *Semantics for Descriptions: From Linguistics to Computer Science*. Stanford: CSLI, 2002.

Rauth, Eric, trans. *Media Manifestos: On the Technological Transmission of Cultural Forms*, by Régis Debray. London: Verso, 1996.

Reeves, Carole. *Egyptian Medicine*. Princes Risborough: Shire Publications Ltd., 1992.

Reiser, Stanley Joel. "Technology and the Eclipse of Individualism in Medicine." *Pharos* 45 (1982): 10-15.

Reivich, Martin. "Positron Emission Tomography." In *Encyclopedia of Neuroscience*. Edited by George Adelman and Barry H. Smith. Amsterdam: Elsevier, 1999.

Richer, Paul M. L. P. *Études cliniques sur la grande hystérie ou hystéro-épilepsie: Avec 197 Figures intercalées dans le texte et 10 gravures à l'eau-forte*. Paris: Adrien Delahaye et Émile Lecrosnier, 1885.

Ricoeur, Paul. *Interpretation Theory: Discourse and the Surplus of Meaning*. Fort Worth: The Texas Christian University Press, 1976.

Roesler, Hugo. *Clinical Roentgenology of the Cardiovascular System*. Springfield: C. C. Thomas, 1943.

Romanell, Patrick. *John Locke and Medicine: A New Key to Locke*. Buffalo: Prometheus Books, 1984.

Röntgen, Wilhelm Conrad. "On a New Kind of Rays." *Nature* 53, no. 1369 (1896): 274-76.

Rose, Nikolas. "Neurochemical Selves." *Society* 41 (2003): 46-59.

Said, Edward W. *Orientalism*. New York: Vintage Books, 1978.

Sarton, George. "The Discovery of X-rays." *Isis* 26 (1937): 349-64.

Sartre, Jean-Paul. *Critique de la raison dialectique, t. I—Théorie des ensembles pratiques*. Paris: Gallimard, 1960.

Satomura, Shigeo. "Ultrasonic Doppler Method for the Inspection of Cardiac Functions." *Journal of the Acoustical Society of America* 29 (1957): 1181-85.

Scarry, Elaine. *The Body in Pain: The Making and Unmaking of the World*. New York: Oxford University Press, 1985.

Schilder, Paul, and Erwin Stengel. "Asymbolia for Pain." *Archives of Neurology and Psychiatry* 25 (1931): 598-600.

Schmidt, Siegfried J. *Kognitive Autonomie und soziale Orientierung: Konstruktivistische Bemerkungen zum Zusammenhang von Kognition, Kommunikation, Medien und Kultur*. Frankfurt am Main: Suhrkamp, 1994.

Schudson, Michael. *Discovering the News: A Social History of American Newspapers*. New York: Basic Books, 1978.

Sebeok, Thomas A. *Sight, Sound, and Sense*. Bloomington: Indiana University Press, 1978.

Selin, Helaine, ed. *Medicine Across Cultures: History and Practice of Medicine in Non-Western Cultures*. Dordrecht: Kluwer Academic Publishers, 2003.

Seneca, Lucius Annaeus, Jr. *Ad Lucilium epistulae morales*. London: William Heinemann Ltd, 1962-67.

Serres, Michel. *The Birth of Physics*. Manchester: Clinamen Press, 2000.

Serres, Michel, and Bruno Latour. *Conversations on Science, Culture, and Time*. Ann Arbor: The University of Michigan Press, 1998.

Sextus Empiricus. *Against the Logicians*. London: William Heinemann Ltd., 1961.

Shieh, Yao Y., and Mason Shieh. "Teleradiology Case: Present and Future." In *E-health Care Information Systems: An Introduction for Students and Professionals*. Edited by Joseph Tan. San Francisco: Jossey-Bass, 2005.

Shields, Rob. *The Virtual*. London: Routledge, 2003.

Shilling, Chris. *The Body and Social Theory*. London: Sage, 1994.

Siegert, Bernhard. *Relays: Literature as an Epoch of the Postal System*. Stanford: Stanford University Press, 1999.

Sochurek, Howard. "Medicine's New Vision." *National Geographic* 17 (1987): 2-41.

Sonesson, Göran. "Iconicity in the Ecology of Semiosis." In *Iconicity—A Fundamental Problem in Semiotics*. Edited by Troels Degn Johansson et al. Åhrus: Nordic Summer University Press, 1999.

Sonka, Milan et al. *Image Processing, Analysis, and Machine Vision*. Toronto: Thomson Learning, 2008.

Sontag, Susan. *On Photography*. New York: Anchor Books, 1990.

Sophocles. *Antigone*. London: William Heinemann, 1928.

Sorabji, Richard. *Emotion and Peace of Mind: From Stoic Agitation to Christian Temptation*. Oxford: Oxford University Press, 2002.

Sperber, Dan. "Anthropology and Psychology: Towards an Epidemiology of Representations." *Man (New Series)* 20 (1985): 73-89.

Squire, Balmanno. *The Treatment of Lupus*. London: J. A. Churchill, 1897.

Staiano, Kathryn V. *Interpreting Signs of Illness: A Case Study in Medical Semiotics*. Berlin: Mouton de Gruyter, 1986.

Stead, William T. *Real Ghost Stories*. http://www.gutenberg.org/files/20420/20420-h/20420-h.htm

Sternbach, Richard A. *Pain: A Psychophysiological Analysis*. New York: Academic Press, 1968.

Stjernfelt, Frederik. *Diagrammaticality: An Investigation on the Boundaries of Phenomenology, Ontology, and Semiotics*. Dordrecht: Springer, 2007.

Stocker, Michael, with Elizabeth Hegeman. *Valuing Emotions*. Cambridge: Cambridge University Press, 1996.

Stötzel, Georg, ed. *Germanistik: Forschungstand und Perspektiven, v. 2*. Berlin: Walter de Gruyter, 1985.

Strauss, Anselm L. *Qualitative Analysis for Social Scientists*. Cambridge: Cambridge University Press, 1987.

Strum, S. S., and Bruno Latour. "Redefining the Social Link: From Baboons to Humans." *Social Science Information* 26 (1987): 783-802.

Sudhoff, Karl. *Ein Beitrag zur Geschichte der Anatomie im Mittelalter: spaziell der anatomischen Graphik nach Handschriften des 9. bis 15. Jahrhunderts*. Hildesheim: Georg Olms Verlagsbuchhandlung, 1964.

Sydenham, Thomas. *Medical Observations Concerning the History and Cure of Acute Diseases*. London: The Sydenham Society, 1848.

Tavel, Morton E. *Clinical Phonocardiography and External Pulse Recording*. Chicago: Year Book Medical Publishers, 1985.

Temkin, Owsei. *The Double Face of Janus and Other Essays in the History of Medicine*. Baltimore: The Johns Hopkins University Press, 1977.

Ter-Pogossian, Michel M. "The Origins of Positron Emission Tomography." *Seminars in Nuclear Medicine* 22 (1992): 140-49.

Tertullian. *De anima*. Amsterdam: J. M. Meulenhoff, 1947.

Tesnière, Lucien. *Éléments de syntaxe structurale*. Paris: Klincksieck, 1976.

Thomas Aquinas, St. *Summa Theologiæ*. London: Blackfriars, 1968-75.

Thompson, Jack George. *The Psychobiology of Emotions*. New York: Plenum Press, 1988.

Thornton, John L. *Jan van Rymsdyk: Medical Artist of the Eighteenth Century*. Cambridge: The Oleander Press, 1982.

Thucydides. *History of the Peloponnesian War*. London: William Heinemann, 1956.

Thurtle, Phillip, and Robert Mitchell, eds. *Semiotic Flesh: Information & the Human Body*. Seattle: Walter Chapin Simpson Center for the Humanities, 2002.

Todkill, Anne Marie. "Anomalies and Anonymity." *Canadian Medical Association Journal* 161 (1999): 420.

Tousignant, Noemi. “Pain and the Pursuit of Objectivity: Pain-measuring Technologies in the United States, c. 1890-1975.” PhD diss., McGill University, 2006.

Tucker, Jennifer. “Photography as Witness, Detective, and Impostor: Visual Representation in Victorian Science.” In *Victorian Science in Context*. Edited by Bernard Lightman. Chicago: The University of Chicago Press, 1997.

Ueyama, Takahiro, and Christophe Lécuyer. “Building Science-based Medicine at Stanford: Henry Kaplan and the Medical Linear Accelerator, 1948-1975.” In *Devices and Designs: Medical Technologies in Historical Perspective*. Edited by Carsten Timmermann and Julie Anderson. Basingstoke: Palgrave Macmillan, 2006.

Valenstein, Elliot S. *Great and Desperate Cures: The Rise and Decline of Psychosurgery and Other Radical Treatments for Mental Illness*. New York: Basic Books, 1986.

Valéry, Paul. *Œuvres*. Paris: Librairie Gallimard, 1960.

van Dijck, José. *The Transparent Body: A Cultural Analysis of Medical Imaging*. Seattle: University of Washington Press, 2005.

Vater, Heinz. *Einführung in die Textlinguistik: Struktur, Thema und Referenz in Texten, 2. Auflage*. München: Wilhelm Fink Verlag, 1994.

Vernant, Jean-Pierre. “Feminine Figures of Death in Greece.” *Diacritics* 16, no. 2 (1986): 54-64.

Virchow, Rudolf Ludwig Karl. *Cellular Pathology as Based upon Physiological and Pathological Histology*. Birmingham: The Classics of Medicine Library, 1978.

Vogel, Hermann Wilhelm. *Die chemischen Wirkungen des Lichts und die Photographie in ihrer Anwendung in Kunst, Wissenschaft und Industrie*. Leipzig: F. A. Brockhaus, 1874.

von Staden, Heinrich, ed. *Herophilus: The Art of Medicine in Early Alexandria*. Cambridge: Cambridge University Press, 1989.

von Uexküll, Thure. “Semiotics and Medicine.” *Semiotica* 38, no. 3/4 (1982): 205-15.

Wagner, R. F. et al. “Texture Discrimination: Radiologist, Machine and Man.” In *Vision: Coding and Efficiency*. Edited by Colin Blakemore. Cambridge: Cambridge University Press, 1990.

Wahl, François. “Appendix: Toward a Critique of the Sign.” In *Encyclopedic Dictionary of the Sciences of Language*. Edited by Oswald Ducrot and Tzvetan Todorov. Baltimore: The Johns Hopkins University Press, 1979.

Waldby, Catherine. *The Visible Human Project: Informatic Bodies and Posthuman Medicine*. London: Routledge, 2000.

Wallis, Ray, ed. *On the Margins of Science: The Social Construction of Rejected Knowledge*. Keele: University of Keele, 1979.

Weiss, Otto, and Gerhard Joachim. "Registrierung und Reproduktion menschlicher Herztöne und Herzgeräusche." *Pflügers Archiv European Journal of Physiology* 123 (1908): 341-86.

Wellbery, David E. Foreword to *Discourse Networks 1800/1900*, by Friedrich A. Kittler. Stanford: Stanford University Press, 1990.

Wells, L. H. "Iconographic Origins of Some Early Anatomical Diagrams: A Further Suggestion." *Journal of the History of Medicine and Allied Sciences* 17 (1962): 385-87.

Whillis, J. "Anatomical Illustration." *Journal of Audiovisual Media in Medicine* 24 (2001): 54-59.

Williams, Francis H. "A Method for More Fully Determining the Outline of the Heart by Means of the Fluoroscope Together with Other Uses of This Instrument in Medicine." *Boston Medical & Surgical Journal* 135 (1896): 335-37.

Wood, Robert Williams. "Communications secrètes au moyen de rayons lumineux." *Journal de Physique Théorique et Appliquée* 5e série, tome IX (1919): 77-90.

Woolf, Virginia. *On Being Ill*. London: The Hogarth Press, 1930.

Wootton, Richard. "Telemedicine Consultations." In *Medicine and the Internet*. Edited by Bruce C. McKenzie. Oxford: Oxford University Press, 2002.

Wright, Richard. "Art and Science in Chaos: Contesting Readings of Scientific Visualization." In *FutureNatural: Nature, Science, Culture*. Edited by George Robertson et al. London: Routledge, 1996.

Zatz, Leslie M. "Basic Principles of Computed Tomography Scanning." In *Radiology of the Skull and Brain; v. 5—Technical Aspects of Computed Tomography*. Edited by Thomas H. Newton and D. Gordon Potts. St. Louis: The C. V. Mosby Company, 1981.

Zielinski, Siegfried. *Deep Time of the Media: Toward an Archaeology of Hearing and Seeing by Technical Means*. Cambridge: The MIT Press, 2006.